Matthew W. Gissendanner
Assistant General Counsel
Dominion Energy Southeast Services, Inc.

220 Operation Way, MC C222, Cayce, SC 29033
DominionEnergy.com

May 29, 2020

VIA ELECTRONIC FILING

The Honorable Jocelyn Boyd
Chief Clerk/Administrator
Public Service Commission of South Carolina
101 Executive Center Drive
Columbia, South Carolina 29211

RE: Dominion Energy South Carolina, Inc.'s Request for Approval of an Expanded Portfolio of Demand Side Management Programs and a Modified Demand Side Management Rate Rider
Docket No. 2019-239-E

Dear Ms. Boyd:

In accordance with Order No. 2019-880 in the above-referenced docket, Dominion Energy South Carolina, Inc. hereby files with the Public Service Commission of South Carolina a copy of the Company's Evaluation, Measurement and Verification report ("EM&V Report") for Program Year 9, which consists of the time period December 1, 2018, to November 30, 2019.

By copy of this letter, we are also providing a copy of the EM&V Report to the South Carolina Office of Regulatory Staff and enclose a certificate of service to that effect. We are also providing counsel for the other parties in the above-referenced docket with a courtesy copy of the report.

Very truly yours,

Matthew W. Gissendanner

MWG/kms
Enclosures
cc: Andrew M. Bateman, Esquire
Jeffrey M. Nelson, Esquire
Derrick P. Williamson, Esquire
Stephanie R. Eaton, Esquire
William C. Cleveland IV, Esquire
Jenny P. Pittman, Esquire
(all via First Class U.S. mail and electronic mail w/enclosures)

BEFORE

THE PUBLIC SERVICE COMMISSION OF

SOUTH CAROLINA

DOCKET NO. 2019-239-E

IN RE:

Dominion Energy South Carolina, Request for Approval of an Expanded Portfolio of Demand Side Management Programs, and a Modified Demand Side Management Rate Rider	)))))	**CERTIFICATE OF SERVICE**

This is to certify that I have caused to be served this day copies of **Dominion Energy South Carolina, Inc.'s Evaluation, Measurement and Verification report ("EM&V Report")** to the persons named below at the addresses set forth via U.S. First Class Mail and electronic mail:

Andrew M. Bateman, Esquire
South Carolina Office of Regulatory Staff
1401 Main Street, Suite 900
Columbia, SC 29201
abateman@regstaff.sc.gov

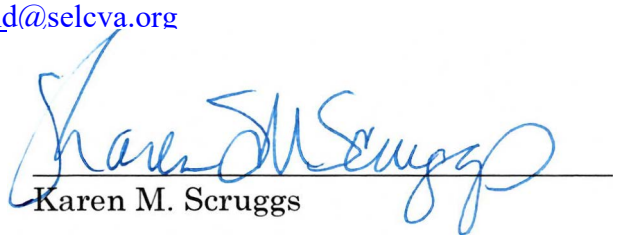
Jeffrey M. Nelson, Esquire
South Carolina Office of Regulatory Staff
1401 Main Street, Suite 900
Columbia, SC 29201
jnelson@regstaff.sc.gov

Jenny Pittman, Esquire
South Carolina Office of Regulatory Staff
1401 Main Street, Suite 900
Columbia, SC 29201
jpittman@regstaff.sc.gov

Derrick Price Williamson, Esquire
Spilman Thomas & Battle, PLLC
1100 Bent Creek Blvd., Suite 101
Mechanicsburg, PA 17050
dwilliamson@spilmanlaw.com

Stephanie U. (Roberts) Eaton, Esquire
Spilman Thomas & Battle, PLLC
110 Oakwood Drive, Suite 500
Winston-Salem, NC 27103
seaton@spilmanlaw.com

William C. Cleveland IV, Esquire
Southern Environmental Law Center
463 King St., Suite B
Charleston, SC 29403
wcleveland@selcva.org



Karen M. Scruggs

Cayce, South Carolina

This 29th day of May 2020

Opinion Dynamics

Boston | Headquarters

617 492 1400 tel
617 497 7944 fax
800 966 1254 toll free

1000 Winter St
Waltham, MA 02451

Dominion Energy South Carolina, Inc. EnergyWise Program Year 9:

Evaluation, Measurement and Verification Report

Megan Campbell
Vice President
May 2020

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1. Executive Summary

Dominion Energy South Carolina, Inc. (DESC) began offering customer energy efficiency programs in October 2010. The period from December 1, 2018, through November 30, 2019, constituted their ninth program year (PY9). Over this period, DESC administered six programs for residential electric customers and two programs for commercial and industrial (C&I) electric customers. The purpose of this report is to provide ex-post PY9 gross, and net program energy and demand savings estimates as compared to the company's forecasted and DESC reported (ex-ante) savings.

DESC forecasted gross savings of 71,738 MWH and 17.3 MW for the PY9 portfolio of energy efficiency programs. The evaluation found ex-post gross savings almost met the energy savings forecast (99%) and fell slightly short of the demand forecast (90%). In PY9, DESC spent approximately $15.2M implementing these programs,[1] which was 10% more than forecast. Table 1 presents gross savings, costs, and participation for each program, comparing each to PY9 forecasts.

In PY9, DESC continued to help customers adopt more energy-efficient lighting through an ENERGY STAR® Online Lighting Store, giveaways to customers visiting DESC business office locations, and mailed LED bulbs to targeted customers in hard-to-reach areas. DESC continued to help income-qualified customers save energy and reduce energy bills by installing energy-efficient lighting and other products through its Neighborhood Energy Efficiency Program (NEEP). In addition, DESC continued to offer weatherization measures for income-qualified mobile home customers. Heating & Cooling, Appliance Recycling Program (ARP), Home Energy Check-up (HEC), and Home Energy Reports (HER) continued to serve residential customers in PY9, and the Small Business Energy Solutions (SBES) and EnergyWise for Your Business (EWfYB) Programs continued to help commercial customers seize energy-efficient opportunities.

Since 2014, Energy Security and Independence Act (EISA) standards have continued to shift lighting baselines from incandescent to halogen, significantly reducing savings year-over-year for the ENERGY STAR® Lighting program as well as other programs, such as HEC and NEEP, that provide LED lighting. The Evaluation Team has worked closely with DESC to monitor the lighting market in South Carolina and adjusted savings estimates to reflect the gradual phasing out of incandescent lamps. The ENERGY STAR® Lighting program still accounts for the largest share of residential program savings but DESC anticipates that, despite the postponement of the next phase of EISA (EISA 2.0; originally planned for 2020), the lighting market will continue to change and, as such, the net savings potential of lighting will continue to decrease. As such, DESC is working actively within the PY10-PY14 program cycle to identify and leverage new opportunities for savings.

Some key highlights from this evaluation of the PY9 programs are bulleted below. These findings are further detailed in each program's chapter of this report.

- Product sales through the Online Store far exceeded expectations for this year. DESC also introduced a number of non-lighting products over the last two years: advanced power strips, low-flow faucet aerators, low flow showerheads, and thermostatic shower valves.
- The HER program fell short of savings forecasts. DESC removed over 1,700 negative savers[2] from the program in PY8 and new customer enrollment was much lower in PY9 compared to previous years. This slowdown in enrollment is by design, as DESC works toward a redesign for this program in the next program cycle.

[1] Program costs reported here do not account for amortization or interest.

[2] The Evaluation Team had identified these customers as "negative savers" based on PY7 evaluation results. DESC verified that these customers were not opening their web links to view their reports before removing them from the program.

- The Home Energy Check-Up program exceeded participation targets but fell short of energy and demand savings forecasts due to increases in the baseline efficiency levels for lighting and the application of in-service rates (ISRs) to leave-behind measures.
- As it has in past years, the Heating & Cooling program continued to exceed forecasts in terms of participation and energy savings and the NEEP program reached more limited income customers and garnered more savings than expected.
- The commercial programs performed well in PY9, reaching more Small Businesses than expected and exceeding energy saving expectations.

Table 1. Portfolio Ex-Post Gross Savings, Costs and Participation

Program Name	Ex-Post Gross Savings				Program Costs		Participation		
	MWH Actual	% of Forecast	MW Actual	% of Forecast	Actual	% of Forecast	Actual	% of Forecast	Definition
ENERGY STAR® Lighting	6,656	82%	0.61	75%	$837,444	60%	212,013	148%	Bulbs/Fixtures
Home Energy Reports	2,394[a]	15%	0.90[a]	15%	$446,102	58%	37,335	86%	Customers / Households
Heating & Cooling	4,641	292%	3.35	299%	$2,621,751	173%	5,446	103%	Measures
Neighborhood Energy Efficiency Program	3,761	154%	0.40	99%	$1,408,521	123%	3,607	149%	Customers
Appliance Recycling	3,344	138%	0.38	127%	$680,639	107%	3,283	103%	Measures
Home Energy Check-up	1,924	83%	0.27	58%	$849,313	99%	3,651	105%	Customers
EnergyWise for Your Business	40,572	121%	7.06	114%	$5,184,879	108%	606	88%	Projects
Small Business Energy Solutions	7,551	136%	2.65	141%	$3,225,894	118%	781	116%	Projects
Total	**70,842**	**99%**	**15.62**	**90%**	**$15,254,543**	**110%**	**202,270**	**132%**	

Notes: This report compares ex-post gross savings to PY9 forecasts stated in Dominion Energy South Carolina's Annual Update on Demand Side Management Programs and Petition to Update Rate Rider submitted in January 2020 to the Public Service Commission of South Carolina https://dms.psc.sc.gov/Web/Dockets/Detail/117378; program costs presented in the report do not account for amortization or interest (carrying costs).

[a] Home Energy Report values are in Ex-Post Net MWH and MW Savings

The overall portfolio achieved net savings (savings attributable to DESC's program offerings) of 54,251 MWH and 12.36 MW, which amounts to approximately three-quarters of the gross energy and demand savings. The net-to-gross-ratios (NTGRs) indicate that DESC's incentives and services are influencing the majority of program-participating customers to save energy.

Table 2. PY9 Ex-Post Gross and Net Savings

Program Name	Energy Savings			Demand Savings		
	Gross MWH Savings	NTGR	Net MWH Savings	Gross MW Savings	NTGR	Net MW Savings
EnergyWise for Your Business	40,572	0.72	29,212	7.06	0.75	5.29
Small Business Energy Solutions	7,551	0.95	7,211	2.65	0.98	2.60
ENERGY STAR® Lighting	6,656	0.75	4,978	0.61	0.75	0.46
Heating & Cooling	4,641	0.70	3,267	3.35	0.68	2.27
Neighborhood Energy Efficiency Program (NEEP)	3,761	1.00	3,761	0.40	1.00	0.40
Appliance Recycling	3,344	0.62	2,083	0.38	0.65	0.25
Home Energy Reports	2,394	1.00	2,394	0.90	1.00	0.90
Home Energy Check-up	1,924	0.70	1,346	0.27	0.77	0.21
Total	**70,842**		**54,251**	**15.62**		**12.36**

Note: Some values in this table do not sum or divide exactly due to rounding.

As shown in Table 3, most of the PY9 energy savings came from the two commercial programs followed by the Residential Lighting program.

Table 3. Program Contribution to Overall Portfolio Gross and Net MWH Savings

Program	Contribution to Gross MWH	Contribution to Net MWH
EnergyWise for Your Business	57%	54%
Small Business Energy Solutions	11%	13%
ENERGY STAR® Lighting	9%	9%
Heating & Cooling	7%	6%
Neighborhood Energy Efficiency Program	5%	7%
Appliance Recycling	5%	4%
Home Energy Reports	3%	4%
Home Energy Check-up	3%	2%

Table 4 compares the ex-post gross savings (total estimated savings, exclusive of free ridership (FR) and spillover) to the savings reported in DESC's Annual Update on Demand Side Management (DSM) Programs and Petition to Update Rate Rider submitted in January 2020 to the Public Service Commission of South Carolina (ex-ante). The PY9 impact evaluation found ex-post savings equal to 99% of the ex-ante energy savings and 102% of the ex-ante demand savings.

Table 4. PY9 Ex-Post Gross Realization Rates

Program Name	MWH			MW			Reasons for difference between Ex-Ante and Ex-Post
	Ex-Ante	Ex-Post	RR	Ex-Ante	Ex-Post	RR	
EnergyWise for Your Business	39,691	40,572	102%	7.51	7.06	94%	Updated baseline efficiency values for Unitary HVAC and Chillers.
Small Business Energy Solutions	7,540	7,551	100.1%	1.83	2.65	145%	Reasons for differences amongst lighting measures were mainly due to a lack of demand savings for exterior lighting measures in ex-ante records, applying coincidence and waste heat factors to ex-post calculations. Reasons for differences amongst the refrigeration measures were driven by a lack of demand savings for some measures.
ENERGY STAR® Lighting	8,423	6,656	79%	0.72	0.61	85%	Primarily the application of ISRs; also includes minor adjustments to savings based on rounding differences or incorrect wattage assumptions, and revised deemed savings for new measures.
Heating & Cooling	4,633	4,641	100%	3.35	3.35	100%	Realization rate is not exactly 100%; Removal of 12 duplicate measures, adjustments to tonnage assumptions, and corrections to savings calculations for a small number of projects.
Neighborhood Energy Efficiency Program	3,799	3,761	99%	0.40	0.40	99%	Application of persistence rates for direct install measures.
Appliance Recycling	3,321	3,344	101%	0.38	0.38	101%	Updated per-unit savings using actual appliance characteristics in PY9 data
Home Energy Reports	2,410	2,394	99%	0.90	0.90	99%	Removal of 253 customers from ex-post participation counts who final billed or opted out prior to receiving a PY9 report.
Home Energy Check-up	2,069	1,924	93%	0.28	0.27	97%	Application of ISRs for leave-behind measures and the addition of lighting carryover savings
Total	**71,887**	**70,841**	**99%**	**15.38**	**15.62**	**102%**	

2. Evaluation Methods

The purpose of this report is to verify the actual PY9 gross and net program energy and demand savings estimates and compare them to the company's forecast and ex-ante estimates. The Evaluation Team conducted a variety of data collection and analytical methods to verify gross and net savings for each program. Given that many of the programs and measures were evaluated in recent years, and that most programs did not change their design or measure-mix offered, PY9 evaluation efforts relied upon much of the recent evaluation efforts for In-service rates (ISRs) and net-to-gross ratios (NTGR). A high-level description of the evaluation methods applied to all programs in PY9 is provided below.

- **Database Review Verification:** The Evaluation Team reviewed program-tracking databases to ensure that there were no duplicates or database errors and that DESC had accurately applied all agreed-upon PY9 deemed savings for each measure.

- **Engineering Desk Review & Analysis:** The Evaluation Team conducted a full engineering desk review of measures in PY1-PY8 evaluations. As a result, the Evaluation Team recommended the application of new deemed savings estimates for some measures prospectively in future program years. The team conducted this activity again in PY9 for select programs and measures. For example, new products were introduced to the Online Store and received an engineering desk review to validate deemed savings assumptions, the Appliance Recycling Program measure savings were evaluated based on the type of measures that were recycled in PY9. Heating and Cooling measure savings were also evaluated based on the baseline conditions, measure, and household characteristics in PY9.

- **Application of Previous Evaluated Inputs:** The Evaluation Team and DESC determined where to focus evaluation funds in PY9 based on implementation costs, specific needs for each program, and how the program was evaluated in previous years. As such, some of the previous evaluation findings were applied to PY9 savings. For example, ISRs for measures in the NEEP and SBES programs were developed in previous evaluations and were applied to the measure counts in PY9.

This report contains a chapter for each program that provides more detailed data collection and analytical methods, and even further details can be found in the Appendices. More rigorous evaluation methods are warranted in future program years and will occur in concert with the implementation timeline for new and expanded programs in PY10. The Evaluation Team will work with DESC to determine the appropriate timing of evaluation activities based on the implementation timeline of expanded and new offerings.

3. Program-Specific Findings

3.1 ENERGY STAR® Lighting Program

3.1.1 Program Description

The ENERGY STAR® Lighting Program offers LEDs to customers through three distinct channels as well as an assortment on non-lighting products. PY9 was the fifth year of the EnergyWise Savings Store (Online Store) and Business Office Lighting (BOL) offerings and the third year of the Low-Income Free LED Kits offering.

Online Store

The Online Store offers residential customers a range of standard and specialty LED products at discounted prices. Additionally, DESC recently introduced a number of non-lighting products: advanced power strips in PY8 and low-flow faucet aerators, low flow showerheads, and thermostatic shower valves in PY9. In PY9, DESC also added three types of "Energy Saver" kits, which provided 15 standard and specialty bulbs and, in two of the three kit types, an advanced power strip. Only customers with DESC electric service could purchase products through the Online Store, thus eliminating leakage to non-DESC customers. Customers had the option to purchase products offered online or over the phone and were limited to purchases of 15 bulbs per eligible customer account per year based on previous Evaluation, Measurement, and Verification (EM&V) recommendations. Energy Federation Inc. (EFI) continued to implement the program in PY9. Program marketing included direct mail to those who had not already participated, bill inserts, online banner ads, news releases, cross-marketing through other DSM programs, and promotions on the DESC website homepage. Also, paid social media platforms such as Facebook and Instagram.

Business Office Lighting

In an effort to reach underserved customer segments, DESC offered free LED kits to customers who visited select DESC business offices across the DESC service area. Through internal analysis, DESC had previously determined that the majority of customers who frequent their business offices have low to moderate incomes. The BOL LED kits consisted of five standard LEDs, including three 60-Watt equivalent bulbs, one 75-Watt equivalent bulb, and one 100-Watt equivalent bulb. Any DESC residential electric customer visiting the participating business offices during the promotional periods was eligible to receive one free kit per eligible residential account.

Low-Income Free LED Kits

DESC mailed postcards to targeted neighborhoods with a high proportion of income-qualified customers based on U.S. Census data. This channel supplements the Neighborhood Energy Efficiency Program (NEEP) by cost-effectively reaching additional income-qualified neighborhoods that are too small for inclusion in NEEP. Postcard recipients could claim one free LED kit by requesting it online or via telephone using a promo code. Each kit contained five standard 60-Watt-equivalent LEDs.

3.1.2 Program Performance Summary

Table 5 shows the program performance summary. DESC exceeded its forecast for distributed products at less than half of the forecasted cost. The program fell short of savings forecasts due to the application of in-service rates (ISRs).

Table 5. ENERGY STAR® Lighting Program Forecasts and Results

Metric	Forecast	Actual	% of Forecast Accomplished
Cost	$1,389,088	$837,444	60%
Products	143,052	212,013	148%
Gross MWH Savings	8,147	6,656	82%
Gross MW Savings	0.81	0.61	75%
Net MWH Savings	N/A	4,977	N/A
Net MW Savings	N/A	0.46	N/A

Note: Values rounded for reporting purposes.

3.1.3 Impact and Data-Tracking Findings

The Evaluation Team reviewed program-tracking data and deemed savings values for accuracy and completed an engineering review to determine revised gross savings for new products. Detail on the methods for evaluating new products is available in Appendix A. The Evaluation Team then applied channel-specific ISRs to determine ex-post gross savings and then channel-specific NTGRs to estimate ex-post net savings. Finally, the team applied carryover savings from products distributed during PY7 and PY8 and installed in PY9.

Table 6 summarizes PY9 energy and demand savings, by channel and for the program overall. The Online Store was the core contributor to overall program savings, accounting for 87% of ex-post gross savings from PY9 products. Before applying carryover savings from PY7 and PY8, the program gross savings realization rate was 65% for energy savings and 71% for demand savings. The application of ISRs account for the vast majority of the discrepancy between ex-ante and ex-post gross savings. The realization rate also reflects relatively minor adjustments to savings based on rounding differences (primarily impacting demand savings) and engineering reviews of savings estimates. With the addition of carryover savings, final realization rates increased to 79% for gross energy savings and 85% for gross demand savings.

Table 6. ENERGY STAR® Lighting Program Ex-Post Gross and Net Savings Summary

Program Component	Verified Product Quantity	Ex-Ante Gross Savings		Revised Gross Savings		Ex-Post Gross Savings		Gross Savings Realization Rate		Ex-Post Net Savings	
		MWH	MW	MWH	MW	MWH	MW	MWH	MW	MWH	MW
Online Store	185,068	7,304	0.62	7,359	0.67	4,781	0.44	65%	71%	3,490	0.32
Business Office Lighting	20,125	873	0.08	873	0.08	585	0.05	67%	70%	485	0.04
Low-Income Free LED Kits	6,820	246	0.02	246	0.02	150	0.01	61%	61%	143	0.01
PY9 product savings	**212,013**	**8,423**	**0.72**	**8,478**	**0.78**	**5,516**	**0.51**	**65%**	**71%**	**4,118**	**0.38**
Carryover savings from PY7 products						562	0.05	N/A	N/A	422	0.04
Carryover savings from PY8 products						578	0.05	N/A	N/A	438	0.04
Total PY9 savings						**6,656**	**0.61**	**79%**	**85%**	**4,977**	**0.46**

Note: Values rounded for reporting purposes.

The sections below detail the evaluation results for each channel.

Online Store Impact

The Online Store provided over 180,000 LEDs of various wattages, more than 2,500 advanced power strips, and 32 water-saving products.

The Evaluation Team reviewed program-tracking data for errors, such as unrealistic or missing values and the accuracy of deemed savings values for all products. The total revised gross savings for Online Store is higher than total ex-ante gross savings, which reflects several adjustments: 1) the Evaluation Team developed deemed savings values for 27 new products that DESC introduced in PY9, including new water-saving products; 2) the team updated the deemed savings estimates for three existing products; and 3) the team corrected minor inconsistencies in the rounding of deemed savings values across a number of existing products. Details on the engineering review are available in Appendix A. To estimate ex-post savings, the team applied the PY6-evaluated ISR of 64% for online store lighting products and a 100% ISR for non-lighting products. DESC added non-lighting products to the program after the PY6 and, as such, their ISRs have not been evaluated. Considering their relatively small contribution to overall PY9 Online Store savings (less than 2%), the Evaluation Team determined it was reasonable to assume an ISR of 100% pending further evaluation; the team plans to evaluate ISRs for all products in PY10.

As shown in Table 7, the Online Store channel achieved 4,781 MWH and 0.44 MW in ex-post gross savings. The Evaluation Team applied the PY6-evaluated NTGR of 0.73, resulting in ex-post net savings of 3,490 MWH and 0.32 MW.

Table 7. Online Store Savings Summary

Online Store	MWH	MW
Ex-Ante Gross Savings	7,304	0.62
Revised Gross Savings	7,359	0.67
ISR	0.65 [a]	
Ex-Post Gross Savings	**4,781**	**0.44**
NTGR	0.73	
Ex-Post Net Savings	**3,490**	**0.32**

Note: Values rounded for reporting purposes.
a. A weighted value based on the PY6-evaluated 64% ISR for lighting products (98% of savings) and an assumed 100% ISR for non-lighting products (less than 2% of savings).

Business Office Lighting Impacts

The BOL channels provided over 4,000 five-LED kits, altogether containing over 20,000 LEDs of various wattages.

Review of the BOL tracking data revealed no data tracking errors, although some customers received two kits (26 customers out of over 4,000). After reviewing the tracking data, the Evaluation Team reviewed deemed savings and found that ex-ante per-unit savings were accurate beyond minor rounding adjustments. The Team then applied the PY6-evaluated ISR of 67% to determine ex-post gross savings.

As shown in Table 8, the BOL channel achieved 585 MWH and 0.05 MW in ex-post gross savings. The Evaluation Team applied the PY6-evaluated NTGR of 0.83, resulting in ex-post net savings of 485 MWH and 0.04 MW.

Table 8. Business Office Lighting Savings Summary

BOL	MWH	MW
Ex-Ante Gross Savings	873	0.08
Revised Gross Savings	873	0.08
ISR	0.67	
Ex-Post Gross Savings	**585**	**0.05**
NTGR	0.83	
Ex-Post Net Savings	**485**	**0.04**

Note: Values rounded for reporting purposes.

Low-Income Free LED Kits Impacts

The Low-Income Free LED Kits channel provided over 1,300 five-LED kits, altogether containing over 6,800 LEDs.

Review of the Low-Income Free LED Kits tracking data revealed no data tracking errors. After reviewing the tracking data, the Evaluation Team reviewed deemed savings and found that ex-ante per-unit savings were accurate beyond minor rounding adjustments. The team then applied the PY6-evaluated ISR of 61% to determine ex-post gross savings.

As shown in Table 9, the Low-Income Free LED Kits channel achieved 150 MWH and 0.01 MW in ex-post gross savings. The Evaluation Team applied the PY6-evaluated NTGR of 0.95, resulting in ex-post net savings of 143 MWH and 0.01 MW.

Table 9. Low-Income Free LED Kits Savings Summary

Low-Income Free LED Kits	MWH	MW
Ex-Ante Gross Savings	246	0.02
Revised Gross Savings	246	0.02
ISR	0.61	
Ex-Post Gross Savings	**150**	**0.01**
NTGR	0.95	
Ex-Post Net Savings	**143**	**0.01**

Note: Values rounded for reporting purposes.

Carryover Savings

In addition to the first-year savings from bulbs DESC distributed in PY9, total ex-post savings also include savings from bulbs that DESC distributed in prior program years and customers installed in PY9. Using an installation trajectory based on the Uniform Methods Project (UMP) approach, the Evaluation Team estimated that PY7 and PY8 bulb sales contributed 860 MWH and 0.08 MW in ex-post net carryover savings (Table 10). Appendix A contains further detail on carryover savings calculations.

Table 10. ENERGY STAR® Lighting Program Carryover Savings Claimed in PY9

Program Year	Ex-Post Gross Savings		Ex-Post Net Savings	
	MWH	MW	MWH	MW
Carryover from PY7	562	0.05	422	0.04
Carryover from PY8	578	0.05	438	0.04
Claimable carryover savings in PY9	**1,140**	**0.10**	**860**	**0.08**

Note: Values rounded for reporting purposes.

3.2 Home Energy Reports Program

3.2.1 Program Description

The Home Energy Reports (HER) Program offers free monthly or bi-monthly reports to customers, comparing their energy usage over time to a peer group. The reports also provide information to help participants identify, analyze, and act upon energy efficiency upgrade opportunities and energy-saving behaviors to reduce their household energy usage. The initial HER is a four-page customized report that provides participants with a summary of their household energy use and focuses on whole-house electricity usage. After the introductory report, subsequent monthly or bi-monthly Home Energy Updates compare the customers' usage to that of a peer group, promote a variety of customized energy efficiency tips and provide information about other DESC EnergyWise programs.

The HER Program offers three different treatment options, including a mailed paper report, an e-mailed report and an e-mailed report in combination with an online portal. Customers using the online portal have the opportunity to create a Custom Action Plan, wherein they can develop personalized energy efficiency goals.

DESC program staff use an "opt-in" model to recruit customers into the HER program. This opt-in model is distinct from other HER programs implemented across the country, as most are offered as an "opt-out" model, where customers default into the program using a randomized experimental design approach. The implementer, Direct Options, purchases demographic data that corresponds with DESC's customer base and uses this data to select specific customers to target for program enrollment. Direct Options targets customers with characteristics that are likely to achieve higher savings, such as high rates of energy use.

To enroll, DESC invites customers to complete an initial Home Energy Survey and set an energy savings forecast. The Home Energy Survey asks details about their home, household appliances, and equipment. Once complete, respondents receive the HER reports. If a customer no longer wants to receive the reports, they can cancel the reports online or contact a DESC customer representative.

3.2.2 Program Performance Summary

As shown in Table 11, the HER program fell short of savings forecasts. The difference between actual accomplishments and forecasts is primarily due to significantly lower average savings per household compared to forecasts. Another contributing factor is that PY9 participation levels were lower than forecasts. In addition to the typical final bill and opt-out customers, DESC also removed over 1,700 negative savers[3] from the program in PY8. Further, new customer enrollment was much lower compared to previous years; 28 customers enrolled in PY9 compared to over 3,800 in PY8. This slowdown in enrollment is by design, as DESC works toward a redesign for this program in the next program cycle.

Table 11. HER Program Forecasts and Results

Metric	Forecast	Actual	% of Forecast Accomplished
Cost	$775,720	$446,102	58%
Participants (Treatment Households)	43,487	37,335	86%
Net MWH Savings	15,711	2,394	15%
Net MW Savings	6.14	0.90	15%

Note: Values rounded for reporting purposes.

3.2.3 Impact and Data-Tracking Findings

To determine ex-post savings, the Evaluation Team reviewed program tracking data for accuracy and then applied PY8-evaluated per-household savings to each active PY9 participant.

As shown in Table 12, there was a small discrepancy between ex-ante and ex-post participation counts. The Evaluation Team reviewed the first PY9 report calendar date for all customers who exited the program mid-year. Amongst these customers, 253 never received a report before exiting the program. Ex-post participant counts exclude these customers, resulting in 37,355 verified PY9 participants.

[3] The Evaluation Team had identified these customers as "negative savers" based on PY7 evaluation results. DESC verified that these customers were not opening their web links (thought they were not opening emails???) to view their reports before removing them from the program.

Table 12. PY9 HER Participation

Program Participants	Ex-Ante	Ex-Post	Difference
Total active PY9 participants	37,588	37,335	(253)
Exited mid-year: Final bill	*2,461*	*2,435*	*(26)*
Exited mid-year: Opt-out	*304*	*77*	*(227)*
Enrolled mid-PY9	*28*	*28*	*-*

After confirming the number of participating households, the Evaluation Team determined ex-post net savings for the program by applying the average annual savings per-household to the 37,355 verified active PY9 participants. Note, the consumption analysis models the Evaluation Team used to estimate average annual savings accounted for cases of prorated savings when customers left the program or enrolled in the program mid-year. As such, all participants receive the same deemed savings value.

PY9 ex-post net savings was 0.41% of household consumption, or 64.11 KWH, and 0.024 KW per household. Applying these values to each participant resulted in 2,394 MWH and 0.90 MW in total ex-post net savings. Table 13 shows ex-post net savings compared to ex-ante. The realization rate for the program was 99% for MWH savings and MW savings. The only source of discrepancy between ex-post and ex-ante savings is the removal of 253 customers who did not receive reports from ex-post participation counts.

Table 13. HER Ex-Post Net Savings Summary

HER Program	Ex-Ante	Ex-Post	Realization Rate
Total participants (treatment households)	37,588	37,335	99%
Net Adjusted Savings			
Percent savings per household	0.41%	0.41%	100%
Average annual savings per household (KWH)	64.11	64.11	100%
Average annual savings per household (KW)	0.02	0.02	100%
Total Program Savings			
Program savings, all households (MWH)	2,410	2,394	99%
Program savings, all households (MW)	0.90	0.90	99%

Note: Values rounded for reporting purposes.

3.3 Heating & Cooling Program

3.3.1 Program Description

The Heating & Cooling Program offers rebates to DESC residential electric customers for installing high-efficiency air conditioners (ACs) and heat pumps (HPs) and improving ductwork. The program's primary goal is to assist customers with reducing electric consumption without compromising comfort in the home. To participate in the program, a customer must receive residential electric service from DESC in an existing, separately metered residence. Program marketing included monthly bill inserts, paid social media on Facebook and Instagram, news releases and quarterly education/outreach to contractors through email.

The largest component of the program is Heating & Cooling Equipment rebates, which help offset the upfront cost for purchases of energy-efficient ENERGY STAR®-qualified HVAC units. The rebates vary according to HVAC type and efficiency level of the installed equipment. The second component of the program is Ductwork

rebates, which supports sealing and/or insulation of existing duct systems as well as complete duct replacement. Table 14 summarizes the rebates offered to customers. Notably, DESC significantly increased Heating & Cooling rebates in mid-PY8; as such, PY9 was the first full year with the revised rebate levels.

Table 14. Heating & Cooling Program PY9 Program Measures and Rebate Amounts

Equipment Type	Minimum Efficiency Requirements	Rebate Amount
Packaged central air conditioner (CAC), air-source heat pump (ASHP) and dual fuel heat pump (DFHP)	15 SEER and 12 EER (and 8.2 HSPF for HPs)	$300
	CACs: ≥ 16 SEER and ≥ 12.5 EER HPs: ≥ 16 SEER and ≥ 12.2 EER and ≥ 8.3 HSPF	$500
Split CAC, ASHP and DFHP	15 SEER and 12.5 EER (and 8.5 HSPF for HPs)	$300
	≥ 16 SEER and ≥ 13 EER (and ≥ 9 HSPF for HPs)	$500
Duct sealing	Duct leakage must be a 50% improvement of the existing duct leakage rate or 150 CFM reduction in leakage	$150
Duct insulation	Minimum insulation ≥ R-8	$150
Complete duct replacement	Total leakage must be 10% or less	$300

Notes: SEER: Seasonal Energy Efficiency Rating; EER: Energy Efficiency Rating; HSPF: Heating Seasonal Performance Factor; CFM: Cubic Feet per Minute.

3.3.1 Program Performance Summary

Table 15 summarizes PY9 program performance compared to forecasts. As it has in past years, the program performed well in PY9; the program achieved its participation forecast and nearly tripled its savings forecasts.

Table 15. Heating and Cooling Program Forecasts and Results

Metric	Forecast	Actual	% of Forecast Accomplished
Cost	$1,515,610	$2,621,751	173%
Measures	5,305	5,446	103%
Gross MWH Savings	1,588	4,641	292%
Gross MW Savings	1.12	3.35	299%
Net MWH Savings	N/A	3,267	N/A
Net MW Savings	N/A	2.27	N/A

Note: Values rounded for reporting purposes.

In PY9, the program served 4,725 customers who altogether installed 5,446 measures. The Heating & Cooling Equipment component represented most of measures (88%) and ASHPs alone account for more than half of all PY9 measures (60%). The Ductwork component altogether represented 12% of program measures, and complete duct replacements were the most common. Table 16 summarizes the total number of installed PY9 measures.

Table 16. Heating & Cooling Program Number of Measures Rebated

Measure Type		Total Ex-Post PY9 Measures
Heating & Cooling Equipment	ASHP	3,263
	CAC	1,528
	DFHP	5
	Heating & Cooling Equipment subtotal	**4,796**
Ductwork	Complete duct replacement	365
	Duct insulation	251
	Duct sealing	34
	Ductwork subtotal	**650**
Total Heating & Cooling Program Measures		**5,446**

The Heating & Cooling Equipment component was also the largest contributor to overall program savings (85% of energy savings). Table 17 shows the total PY9 ex-post gross savings by program component.

Table 17. Heating and Cooling Program Population Size

Program Component	Ex-Post Gross Savings (MWH)	Ex-Post Gross Savings (MW)
Heating & Cooling Equipment	3,961	3.13
Ductwork	607	0.22
Total	**4,641**	**3.35**

3.3.2 Impact and Data-Tracking Findings

As shown in Table 18, the program achieved 4,641 MWH and 3.35 MW in ex-post gross savings. The gross savings realization rate for the program was approximately 100% for MWH and 100% for MW savings. Although the Evaluation Team identified slight differences from ex-ante energy savings assumptions and measure counts, the impact on overall program savings was minimal (<1%). The Evaluation Team applied previously evaluated NTGRs to estimate total program ex-post net savings of 3,271 MWH and 2.27 MW.

Table 18. Heating and Cooling Program Ex-Post Gross Savings Summary

Program Component	Ex-Ante Gross Savings		Ex-Post Gross Savings		Realization Rate		NTGR		Ex-Post Net Savings	
	MWH	MW	MWH	MW	MWH	MW	MWH	MW	MWH	MW
Heating & Cooling Equipment	3,953	3.12	3,961	3.13	100%	100%	0.72	0.68	2,852	2.13
Ductwork	680 [a]	0.23	680	0.22	100%	100%	0.61	0.62	415	0.14
Total	**4,633** [a]	**3.35**	**4,641**	**3.35**	**100%**	**100%**	**0.70**	**0.68**	**3,267**	**2.27**

Note: Values rounded for reporting purposes.
a. DESC reported 4,633 MWH and 3.35 MW in ex-ante savings to the Commission but the Evaluation Team identified a calculation error in the Ductwork component. The actual ex-ante savings for Ductwork was 681 MWH and 0.23 MW and total program actual ex-ante savings was 4,634 MWH and 3.35 MW.

The following sections provide detailed impact findings for each program component.

Heating & Cooling Equipment Impact Findings

The Evaluation Team reviewed the program-tracking database to verify the total number of rebated measures. As shown in Table 19, the team found 12 duplicate measures in the program-tracking database and removed them from the ex-post analysis.

Table 19. Heating & Cooling Equipment Number of Measures Rebated

Measure	Ex-Ante Quantity	Verification Rate	Ex-Post Quantity
ASHP	3,271	100%	3,263
CAC	1,532	100%	1,528
DFHP	5	100%	5
Total	**4,808**	**100%**	**4,796**

To estimate gross savings for PY9 Heating & Cooling Equipment measures, ex-ante and ex-post calculations apply per-ton deemed savings values. As new measures (i.e., new equipment type and efficiency combinations) enter the program, the Evaluation Team regularly estimates new per-ton deemed savings values. There were two new measures in PY9. For these measures, ex-ante applied a placeholder value, based on a similar existing measure and the Evaluation Team developed new per-ton deemed savings values. Additionally, the Evaluation Team adjusted the tonnage for five projects that had incorrectly tracked tonnage, based on manufacturer information. These adjustments increased savings for these five projects significantly but had a minor impact on overall Heating & Cooling Equipment savings.

The PY9 Heating & Cooling Equipment component achieved ex-post gross savings of 3,961 MWH and 3.13 MW. The realization rates for energy and demand are both approximately 100%. The small difference between total ex-ante and ex-post gross savings reflects several adjustments: 1) revised per-ton deemed savings for two new measures; 2) adjustments to tracked tonnage for five records; and 3) removal of 12 duplicate records. Table 20 compares the total ex-ante and ex-post gross savings by equipment type.

Table 20. Heating & Cooling Equipment Ex-Post Gross Savings Summary

Measure Type	Ex-Ante Gross Savings		Ex-Post Gross Savings		Gross Realization Rate	
	MWH	MW	MWH	MW	MWH	MW
ASHP	3,268	2.55	3,277	2.56	100%	100%
CAC	680	0.57	679	0.57	100%	100%
DFHP	5	0.004	5	0.004	100%	100%
Total	**3,953**	**3.12**	**3,961**	**3.13**	**100%**	**100%**

Note: Values rounded for reporting purposes.

The Evaluation Team applied PY8-evaluated NTGRs to estimate ex-post net savings. As shown in Table 21, the Heating & Cooling Equipment component achieved ex-post net savings of 2,852 MWH and 2.13 MW.

Table 21. Heating & Cooling Equipment Ex-Post Net Savings Summary

Measure Type	Ex-Post Gross Savings		NTGR		Ex-Post Net Savings	
	MWH	MW	MWH	MW	MWH	MW
ASHP	3,277	2.56	0.72	0.68	2,360	1.74
CAC	679	0.57			489	0.38
DFHP	5	0.004			3	0.003
Total	**3,961**	**3.13**	**0.72**	**0.68**	**2,852**	**2.13**

Note: Values rounded for reporting purposes

Ductwork Impact Findings

The Evaluation Team reviewed the program-tracking database to verify the total number of rebated measures. The Evaluation Team found no duplicate records or database errors within the program-tracking database and, therefore, did not adjust ex-ante measure quantities. Table 22 shows the resulting verified ex-post measure quantity is equal to the ex-ante measure quantity.

Table 22. Ductwork Number of Measures Rebated

Measure Type	Ex-Ante Quantity	Verification Rate	Ex-Post Quantity
Complete duct replacement	365	100%	365
Duct insulation	251	100%	251
Duct sealing	34	100%	34
Total	**650**	**100%**	**650**

To estimate gross savings for Ductwork measures, ex-ante and ex-post applied deemed savings value per-ton based on the home's HVAC system capacity (i.e., tonnage). There were 72 Ductwork measures (11%) with unknown HVAC system capacity. In these cases, ex-ante calculations applied a default tonnage assumption of 3.07. The Evaluation Team developed a PY9-specific default assumption for these measures based on the average tonnage across actual PY9 program-tracking data records. The result was a slightly lower ex-post tonnage default assumption, compared to ex-ante, of 3.0 tons. Table 23 compares the total ex-ante and ex-post tons by measure type after updating the default tonnage assumption.

Table 23. Ductwork Ex-Ante and Ex-Post Total Capacity Comparison

Measure Type	Ex-Ante Capacity (Tons)	Ex-Post Capacity (Tons)	% Change
Complete duct replacement	1,094	1,093	-0.17%
Duct insulation	769	732	-4.81%
Duct sealing	100	100	-0.56%
Total	**1,964**	**1,924**	**-2.01%**

There were a few additional savings calculation corrections for nine projects; in three cases, there was a rounding error on tonnage, and, in six cases, ex-ante applied incorrect system quantities to estimate total savings for the project. Correcting these issues increased savings for some projects and decreased savings for others but had little effect overall on Ductwork savings.

As shown in Table 24, PY9 Ductwork measures achieved total ex-post gross savings of 680 MWH and 0.22 MW. The gross realization rate was 100% overall for Ductwork energy and demand savings, although there were minor differences between ex-ante and ex-post savings. These differences primarily reflect: 1) the adjustments to default tonnage assumptions when actual HVAC system capacity is unknown; and 2) savings calculation corrections for nine projects.

Table 24. Ductwork Ex-Post Gross Savings Summary

Measure Type by HVAC System Type	Ex-Ante Gross Savings		Ex-Post Gross Savings		Gross Realization Rate	
	MWH	MW	MWH	MW	MWH	MW
Complete duct replacement (HP)	312	0.08	310	0.08	99%	99%
Complete duct replacement (AC)	202	0.09	200	0.09	99%	99%
Duct sealing (HP)	28	0.01	28	0.01	100%	100%
Duct sealing (AC)	5	0.002	5	0.002	99%	99%
Duct insulation (HP)	92	0.02	94	0.02	103%	103%
Duct insulation (AC)	42	0.02	42	0.02	101%	101%
Total	**680** [a]	**0.23**	**680**	**0.22**	**100%**	**100%**

Note: Values rounded for reporting purposes.
a. DESC reported 4,633 MWH and 3.35 MW in ex-ante savings to the Commission, which included 680 MWH and 0.23 MW in ex-ante savings from Ductwork. However, there was a calculation error for the Ductwork component; the actual ex-ante savings for Ductwork was 681 MWH and 0.23 MW.

The Evaluation Team applied PY3-evaluated NTGRs to estimate ex-post net savings. As shown in Table 25, the Ductwork component achieved ex-post net savings of 415 MWH and 0.14 MW.

Table 25. Ductwork Ex-Post Net Savings Summary

Measure Type by HVAC System Type	Ex-Post Gross Savings		NTGR		Ex-Post Net Savings	
	MWH	MW	MWH	MW	MWH	MW
Complete duct replacement (HP)	310	0.08	0.61	0.62	189	0.05
Complete duct replacement (AC)	200	0.09			122	0.06
Duct sealing (HP)	28	0.01			17	0.005
Duct sealing (AC)	5	0.002			3	0.001
Duct insulation (HP)	94	0.02			58	0.01
Duct insulation (AC)	42	0.02			26	0.01
Total	**680**	**0.22**			**415**	**0.14**

Note: Values rounded for reporting purposes.

3.4 Home Energy Check-Up Program

3.4.1 Program Description

The Home Energy Check-up (HEC) Program provides electric customers in DESC's service territory with a home visit that includes a visual inspection of the home and an energy consultation with the customer. During the

check-up, a DESC representative, who is certified as a Building Analyst Professional through the Building Performance Institute, identifies sources of high energy use, reviews up to two years of consumption data and weather impacts and discusses energy-saving behaviors with the customer (e.g., thermostat settings, water heater settings, etc.). In addition, they provide the customer with free ("leave-behind") measures (Table 26), including LEDs and several hot water measures and a list of recommended energy conservation actions ("recommended measures") (Table 27). The DESC representative provides direct installation of kitchen faucet aerators and, beginning in PY9, provides direct installation of LEDs when replacing incandescent bulbs. Otherwise, the DESC representative leaves additional LEDs, pipe insulation, and electric water heater insulating blankets behind for the customer to self-install.

Table 26. HEC Leave-behind Measures

Leave-behind Measure	Direct Installation Service Provided
Kit of five LED bulbs (three 10-Watt, one 12-Watt, and one 14-Watt)	In cases of incandescent bulb replacement only
Hot water pipe insulation (6 feet), as appropriate when customer has electric water heating	No
Electric water heater insulating blanket, as appropriate when customer has electric water heating	No
Kitchen faucet aerator, as appropriate when customer has electric water heating	Yes

Table 27. HEC Energy Conservation Actions Recommended during the Visit

Recommended Measure
Set thermostat at 68°F or lower in the winter and 78° F or higher in the summer
Install a smart thermostat
Replace air filters
Leave interior doors open and keep vents open for adequate air flow
Repair ducts
Have central heating and cooling system serviced
Upgrade attic insulation to a minimum of R-38
Caulk, seal and weather-strip windows or doors
Adjust water heater temperature to 120°F
Replace incandescent lamps with ENERGY STAR® LEDs
Unplug appliances, lights, TVs, computers, etc. when not in use

Note: Program materials further recommend visiting DESC's website or calling DESC. Information about Heating and Cooling Rebates, the Appliance Recycling Program and the EnergyWise Savings Store were also included in the leave-behind materials.

3.4.2 Program Performance Summary

In PY9, the program exceeded participation targets. Still, it fell short of its energy and demand savings forecasts due to lower per-participant savings than forecasted given increases in the baseline efficiency levels for lighting in the general marketplace and the application of in-service rates (ISRs) to leave-behind measures. Table 28 summarizes the forecasts and actuals in terms of costs, participation, and energy and demand savings.

Table 28. HEC Forecasts and Results

Metric	Forecast	Actual	% of Forecast Accomplished
Costs	$854,004	$849,313	99%
Participants	3,462	3,651	105%
Gross MWH	2,310	1,924	83%
Gross MW	0.47	0.27	58%
Net MWH	N/A	1,346	N/A
Net MW	N/A	0.21	N/A

Note: Values rounded for reporting purposes.

The program performed check-ups for 3,651 residential customers during PY9. Almost all participants received a lighting kit with five LEDs (only eight did not). The hot water measures were less prevalent compared to LEDs because not every participant qualifies to receive them; DESC only provides hot water measures to customers with electric water heating and only when the measure is appropriate (e.g., there is uninsulated hot water pipe or an applicable faucet for an aerator). A small portion of participants (seven; less than <1%) received a check-up but did not receive any leave-behind measures. Table 29 summarizes program participation by each of the measures offered through HEC.

Table 29. HEC Participation by Leave-behind Measure

Measure	Number of Participants Who Received the Measure	% of Total Participants (n=3,651)	Total Measures Provided in PY9
LEDs	3,643	100%	18,215 bulbs
Electric water heater insulating blanket	551	15%	551 blankets
Hot water pipe insulation	495	14%	2,970 feet
Kitchen faucet aerator	228	6%	228 aerators

Note: Measure totals do not sum to 3,651 because some participants received multiple measures.

3.4.3 Impact and Data-Tracking Findings

The impact evaluation included the following steps.

- The Evaluation Team reviewed the program-tracking database for accuracy.
- The team determined ex-post gross saving by applying PY8-evaluated leave-behind measure ISRs and per-unit deemed savings, with the exception of LEDs. For LEDs, the team developed a weighted ISR and weighted per-bulb savings to reflect that DESC directly installed a portion of LEDs to replace incandescent bulbs.
- The team determined ex-post net savings for all measures by applying deemed NTGRs from the PY8 evaluation to ex-post gross savings.
- The team applied carryover savings from lighting measures that DESC distributed in previous years and that customers installed in PY9. The next sections provide detail on each of these steps.

Program-Tracking Database Review

The Evaluation Team reviewed the program-tracking database to verify the total number of participants and leave-behind measures. The Evaluation Team did not find any duplicates or measure counting errors in the program-tracking database. Next, the team applied ISRs to ex-ante measure quantities to determine ex-post measure quantities. Table 30 compares ex-ante and ex-post measure quantities.

Table 30. HEC Leave-behind Measure Verification

Measure	Ex-Ante Measure Quantity	Verified Measure Quantity	ISR [a]	Ex-Post Measure Quantity	Unit
LEDs	18,215	18,215	75%	13,716	Bulbs
Electric water heater insulating blanket	551	551	61%	336	Blankets
Hot water pipe insulation	495	495	70%	347	6-foot packs
Kitchen faucet aerators	228	228	98%	223	Aerators

Note: Values rounded for reporting purposes.
a. ISR source: PY8 evaluation results, with the exception of LEDs; for LEDs, ISR is a weighted value that reflects the relative share of leave-behind and direct install LEDs. See Table 31.

Table 31 below presents the Evaluation Team's calculation of the weighted ISR for LEDs. Based on program-tracking data, 5% of the LEDs replaced incandescent lamps via direct installation. Considering the relatively small proportion of directly installed LEDs, the Evaluation Team determined it was reasonable to assume that customers did not remove the LEDs and applied an ISR of 100% for PY9. The Evaluation Team will update this assumption in PY10 evaluation efforts as direct installation may become more prevalent. For the remaining 95% of LEDs, the team applied the PY8-evaluated ISR of 74%.

Table 31. HEC LED ISR Calculation

LED Provision Method	Percentage of LEDs (N=18,215)	ISR	Weighted ISR
Leave-behind	95%	74% [a]	75%
Direct installation	5%	100%	

a. Source: PY8 evaluation

Ex-Post Gross Savings for PY9 Participants

To calculate ex-post gross savings, the Evaluation Team applied deemed savings values to ex-post measure quantities. As shown in Table 32, the program achieved ex-post gross savings of 1,842 MWH and 0.26 MW from PY9 participants. Recommended measure savings represented over half (56%) of ex-post gross MWH savings, followed by LEDs, which represented a third of savings (33%). More detail on the calculation of ex-post gross savings follows the table.

Table 32. HEC Ex-Post Gross Savings by Measure Type

Program Component	Ex-Post Measure Quantity	Unit	Savings per Unit [a]		Ex-Post Gross Savings	
			KWH	KW	MWH	MW
Recommended measures	3,651	Household	280.06	0.05	1,023	0.19
LEDs	13,716	Bulbs	45.13	0.004	619	0.06
Electric water heater insulating blanket	336	Blankets	360.80	0.04	121	0.01
Kitchen faucet aerators	223	Aerators	225.00	0.01	50	0.002
Hot water pipe insulation	347	6-foot packs	82.30	0.009	29	0.003
Total					**1,842**	**0.26**

Note: Values rounded for reporting purposes.
a. Source: Deemed savings from previous evaluation results, with the exception of LEDs; for LEDs, per-bulb savings is a weighted value that reflects the relative share of leave-behind and direct install LEDs. See Table 33.

Recommended Measures

DESC provided a list of recommended energy conservation actions to all 3,651 customers who received a home energy check-up. The Evaluation Team applied PY8-evaluated per-household energy savings of 280 KWH and demand savings of 0.05 KW to determine ex-post gross savings of 1,023 MWH and 0.19 MW.

LEDs

3,643 customers received a kit of five low-wattage LED bulbs (ranging in wattages) for a total of 18,215 bulbs. The Evaluation Team applied a weighted per-bulb savings value that reflects that DESC directly installed 5% of LEDs to replace incandescent bulbs. As shown in Table 33, the Evaluation Team assumed a halogen bulb baseline for leave-behind LEDs and an incandescent bulb baseline for direct install LEDs.

Table 33. HEC Per-Bulb Savings Calculation

LED Provision Method	Percentage of LEDs (N=18,215)	Assumed Baseline	Per-Bulb Savings		Weighted Per-Bulb Savings	
			KWH	KW	KWH	KW
Leave-behind	92%	Halogen	43.36 [a]	0.004 [a]	45.13	0.004
Direct installation	8%	Incandescent	65.48	0.006		

a. Source: Deemed savings from the PY8 evaluation.

The Evaluation applied the weighted ISR 75% to determine that the ex-post quantity was 13,716, which led to ex-post gross savings of 619 MWH and 0.06 MW.

Electric Water Heater Insulating Blanket

There were 551 customers with electric water heaters that received water heater insulating blankets through the program. The Evaluation Team applied the PY8-evaluated ISR of 61% to determine that the ex-post quantity was 336 blankets, which led to ex-post gross savings of 121 MWH and 0.014 MW.

Faucet Aerators

The program provided direct installation of kitchen faucet aerators to 228 customers. The Evaluation Team applied the PY8-evaluated ISR of 98% to determine that the ex-post quantity was 223 faucet aerators, which led to ex-post gross savings of 50 MWH and 0.002 MW.

Hot Water Pipe Insulation

There were 495 customers with electric water heaters and uninsulated hot water pipes that received six feet of hot water pipe insulation, for a total of 2,970 feet of hot water pipe insulation. The Evaluation Team applied the PY8-evaluated ISR of 70% to determine that the ex-post quantity was 347 six-foot packs (or 2,082 feet), which led to ex-post gross savings of 29 MWH and 0.003 MW.

Program Ex-Post Gross Savings Summary

The program achieved ex-post gross savings of 1,842 MWH and 0.26 MW, resulting in realization rates of 0.89 for MWH and 0.94 for MW savings, as shown in Table 34. The key factor that influences the realization rates is the application of ISRs for all the measures, which reduced ex-post savings compared to ex-ante. Updating the per-bulb savings assumption for LEDs to reflect direct installation to replace incandescent lamps increased ex-post LED savings by about 3% compared to ex-ante. However, this adjustment did not supersede the impact of ISRs on savings.

Table 34. HEC Ex-Post Gross Savings Summary (Before Carryover Savings)

Ex-Ante Gross Savings		Ex-Post Gross Savings		Realization Rate [a]	
MWH	MW [b]	MWH	MW	MWH	MW
2,069	0.28	1,842	0.26	89%	94%

a. Gross realization rate for ex-post PY9 participant savings (Does not include carryover savings)
b. DESC reported 0.28 ex-ante MW to the Commission but the Evaluation Team identified a small rounding error; the actual ex-ante savings is 0.29 MW.
Note: Values rounded for reporting purposes.

Net Verified Savings for PY9 Participants

The Evaluation Team applied PY8-evaluated NTGRs of 0.70 (MWH) and 0.77 (MW) to the total ex-post gross savings to arrive at the total program ex-post net savings. Table 35 summarizes the total net savings for PY9 participants. The program achieved ex-post net savings of 1,289 MWH and 0.20 MW. Note that the total PY9 claimed savings for this program are higher than the ex-post net savings in the table below because the evaluation accounted for PY6, PY7, and PY8 carryover lighting savings (see Table 36).

Table 35. HEC Ex-Post Net Savings Summary (Before Carryover Savings)

Ex-Post Gross Savings		NTG Ratio		Net Savings	
MWH	MW	MWH	MW	MWH	MW
1,842	0.26	0.70	0.77	1,289	0.20

Note: Values rounded for reporting purposes.

Total Net Savings to Claim in PY9

Total claimable net savings in PY9 is greater than the savings from PY9 participants, as it also includes carryover savings from in-storage CFLs and LEDs from prior program years that prior participants installed in

PY9. The Evaluation Team estimated that, in PY9, prior participants installed 622 CFLs from PY6 or PY7 and 1,425 LEDs from PY6, PY7 or PY8. See Appendix B for more detailed carryover savings calculations.

Table 36 summarizes final ex-post gross and net savings for HEC after adding carryover savings. Carryover savings contributed 1,842 MWH and 0.26 MW in additional gross savings, increasing gross realization rates by three to four percentage points. Applying leave-behind measure NTGRs from the years in which DESC distributed the carryover bulbs resulted in 57 MWH and 0.005 MW in additional net savings.

Table 36. HEC Total Savings Claimed in PY9

Program Year	Gross Savings		Net Savings[a]	
	MWH	MW	MWH	MW
Ex-ante PY9 (A)	2,069	0.28[b]	1,635	0.21
Ex-post total carryover savings claimed in PY9 (B)	82	0.007	57	0.005
Ex-post PY9 participants (C)	1,842	0.26	1,289	0.20
Total ex-post savings claim for PY9 (D=B+C)	1,924	0.27	1,346	0.21
Gross Realization Rate (D ÷ A)	**0.93**	**0.97**	**N/A**	**N/A**

a. Net savings take into account the PY6 NTGR for PY6 and PY7 leave-behind CFLs and LEDs (0.79 for electric energy savings and 0.74 for demand savings) as well as the PY8 NTGR for PY8 leave-behind LEDs (0.62 for electric energy savings and 0.62 for demand savings)
b. DESC reported 0.28 ex-ante MW to the commission but the Evaluation Team identified a small rounding error; the actual ex-ante savings is 0.29 MW.

3.5 Neighborhood Energy Efficiency Program

3.5.1 Program Description

The Neighborhood Energy Efficiency Program (NEEP) provides income-qualified residential neighborhoods with in-home energy assessments and low-cost energy-saving measures at no cost to the customer. DESC delivers the program using a neighborhood door-to-door sweep approach and directly installs a variety of energy efficiency measures for customers. DESC delivers the program to neighborhoods where approximately half of the households have income levels equal to or less than 150% of the 2018 poverty guideline, as defined by the federal government. Eligible neighborhoods include single and multifamily residences as well as homeowners and renters. Honeywell assisted DESC as the program implementer providing in-home services to customers.

During the home visits, the DESC representative conducts a walkthrough of the home and makes recommendations for additional ways to save energy. Depending on their needs, participants receive various measures (see direct install measures in Table 37). The program also continued to offer the mobile home weatherization measures that DESC first introduced in PY6. Table 37 lists the measures DESC provides through the program. Notably, all mobile home customers received direct install measures in addition to the weatherization measures.

Table 37. NEEP Measures

Measure/Action	
Direct Install Measures	**Mobile Home Weatherization Measures**
Advanced power strips	Air sealing (various levels of leakage reduction)
HVAC filters	Attic plug & fill insulation (> R-30)
Kitchen faucet aerators	Belly board insulation (> R-19)
LEDs	Belly board repair
Water heater pipe wrap	Carbon monoxide monitor
Water heater blankets	Digital switch plate wall thermometer
Water heater temperature adjustment	Duct sealing with > 10% reduction
	Programmable communicating thermostat
	Reflective roof coating
	Wi-Fi enabled thermostat

Customers also receive a list of tips for saving energy, which encourages them to take additional energy conservation actions following the representative's visit and a checklist of installed measures detailing the benefits of each measure added to their home. Table 38 presents the recommended energy conservation actions on this list.

Table 38. NEEP Energy Conservation Actions Recommended on the List of Tips

Recommended Measure
Set thermostat at 68°F or lower in the winter and 78° F or higher in the summer
Install a smart thermostat
Replace air filters
Leave interior doors open and keep vents open for adequate air flow
Repair ducts
Have central heating and cooling system serviced
Upgrade attic insulation to a minimum of R-38
Caulk, seal and weather-strip windows or doors
Adjust water heater temperature to 120°F
Replace incandescent lamps with ENERGY STAR® LEDs
Unplug appliances, lights, TVs, computers, etc. when not in use

Note: Program materials further recommend visiting DESC's website or calling DESC. Information about Heating and Cooling Rebates, the Appliance Recycling Program and the EnergyWise Savings Store was also included in the leave-behind materials.

3.5.2 Program Performance Summary

The program performed well in PY9. The program exceeded energy savings forecasts by over 50% primarily because DESC greatly exceeded its participation forecast; another contributing factor was that average per-participant MWH savings was approximately 3% higher than forecasted. Table 39 summarizes the forecasted and actual results in terms of costs, participation, and energy and demand savings.

Table 39. NEEP Forecasts and Results

Metric	Forecast	Actual	% of Forecast Accomplished
Cost	$1,142,520	$1,408,521	123%
Participants	2,420	3,607	149%
Gross MWH Savings	2,447	3,761	154%
Gross MW Savings	0.40	0.40	99%
Net MWH Savings	N/A	3,761	N/A
Net MW Savings	N/A	0.40	N/A

Note: Values rounded for reporting purposes

The program performed in-home energy assessments for 3,607 residential customers. All the customers received direct install measures while 120 mobile home customers also received weatherization measures targeted to mobile homes.

Table 40. NEEP Participation by Program Type

Program Component	Number of Participants	% of Total Participants
Direct install only	3,487	97%
Mobile home weatherization + direct install	120	3%
Total program participants	**3,607**	**100%**

The program offered seven different direct install measures to customers. Almost all customers received LEDs (99%) and advanced power strips (97%) and about three-quarters of customers (74%) received kitchen faucet aerators and HVAC filters (either packs of 12 standard size filters or two custom-cut filters). DESC chose which measures to install based on customer need and, on average, customers received three of the seven available direct install measures. Further, the program offered ten different mobile home measures, with the three most common measures being digital switch plate wall thermometers, duct sealing and air sealing. On average, mobile home customers received approximately four of the ten available measures. Table 41 presents the total number of measures the program provided and the number of customers that received each type of measure.

Table 41. NEEP Participation by Component and Measure

Measure	Program Participants	% of Total Participants	Total Measures Distributed in PY9 [a]	Unit
Direct Install Measures (N=3,607)				
LEDs	3,554	99%	41,323	Lamps
Advanced power strips	3,481	97%	3,481	Strips
HVAC filters	2,687	74%	32,044	Filters
Kitchen faucet aerators	2,665	74%	2,665	Aerators
Water heater pipe wrap (1-ft)	1,498	42%	1,498	Feet
Water heater blankets	453	13%	453	Blankets
Water heater temperature adjustment	55	2%	55	Adjustments
Mobile Home Weatherization Measures (N=120)				
Digital switch plate wall thermometer	119	99%	119	Thermometers
Duct sealing with > 10% reduction	117	98%	117	Participants
Air sealing > 30% leakage reduction	60	50%	60	Participants
Air sealing > 40% leakage reduction	60	50%	60	Participants
Attic plug & fill insulation (R-30)	42	35%	42	Square Feet
Programmable communicating thermostat	12	10%	12	Thermostats
Carbon monoxide monitor	33	28%	33	Monitors
Belly board repair	11	9%	11	Square Feet
Reflective roof coating	5	4%	5	Square Feet
Wi-Fi enabled thermostat	3	3%	3	Thermostats
Total	**3,607**	**100%**	**81,981**	**N/A**

a. Total measures distributed does not account for persistence rates.

3.5.3 Impact and Data-Tracking Findings

The Evaluation Team performed a thorough review of the direct install and mobile home program-tracking databases and found no duplicative records or data tracking errors. As shown in Table 42, the team applied persistence rates to ex-ante measure quantities to determine ex-post quantities. Most persistence rates are from PY5 evaluation results. However, for two direct install measures that DESC introduced in PY7, LEDs and kitchen faucet aerators, the Evaluation Team applied a 100% persistence rate as these measures have not yet been evaluated. Previous evaluation efforts for CFL lighting in NEEP resulted in a 99.9% persistence rate for CFLs, therefore a 100% persistence rate for LEDs is a reasonable assumption pending further validation efforts. The team plans to develop persistence rates for these measures in future program years using updated research with participants.

Table 42. NEEP Ex-Ante and Ex-Post Measure Quantity

Measure Type	Ex-Ante Measure Quantity	Persistence Rate	Ex-Post Measure Quantity	Unit
LEDs	41,323	100%	41,323	Lamps
HVAC filters	32,044	100%	32,044	Filters
Advanced power strips	3,481	93%	3,237	Strips
Kitchen faucet aerators	2,665	100%	2,665	Aerators
Water heater pipe wrap (1-ft)	1,498	94%	1,408	Feet
Water heater blankets	453	92%	417	Blankets
Water heater temperature adjustment	55	100%	55	Adjustments
Mobile home weatherization	462	100%	462	Homes
Total	**81,981**	**N/A**	**81,611**	**N/A**

Total Program Ex-Post Gross Impacts

The Evaluation Team reviewed the program-tracking database to verify the appropriate application of deemed savings values. The team did not find any discrepancy in the deemed savings values for any measure. Table 43 shows the per-unit savings for each direct install measure and the per-home deemed savings for mobile home weatherization.

Table 43. NEEP Per-Unit Deemed Savings Values

Measure Description	Unit	Per-Unit Savings	
		KWH	KW
LED 40W equivalent	Per lamp	37.23	0.003
LED 60W equivalent	Per lamp	54.75	0.005
LED 75W equivalent	Per lamp	68.99	0.006
LED100W equivalent	Per lamp	94.17	0.009
HVAC filters (electric heating & cooling)	Per participant	64.00	0.015
HVAC filters (electric cooling only)	Per participant	32.00	0.018
HVAC filters (electric heating only)	Per participant	32.00	0.000
Kitchen faucet aerator	Per aerator	225.00	0.011
Water heater pipe wrap (1-ft)	Per foot	13.72	0.002
Advanced power strips	Per strip	102.80	0.012
Water heater blanket	Per blanket	360.80	0.041
Water heater temperature adjustment	Per adjustment	113.84	0.013
Mobile home weatherization	Per home	1,879.75	0.492

As shown in Table 44, the NEEP program achieved ex-post gross savings of 3,761 MWH and 0.40 MW. LEDs were the largest contributor to gross savings (61%), followed by kitchen faucet aerators (16%). The overall realization rates for the program are 99% for both MWH and MW savings. The only discrepancy between ex-ante and ex-post savings is the application of persistence rates.

Table 44. NEEP Ex-Post Gross Savings Summary

Measure	Ex-Ante Gross Savings		Ex-Post Gross Savings		Gross Realization Rate	
	MWH	MW	MWH	MW	MWH	MW
LEDs	2,279	0.21	2,279	0.21	100%	100%
Kitchen faucet aerators	600	0.03	600	0.03	100%	100%
Advanced power strips	358	0.04	333	0.04	93%	93%
Water heater blankets	163	0.02	150	0.02	92%	92%
HVAC filters	147	0.04	147	0.04	100%	100%
Water heater pipe wrap	21	0.00	19	0.00	94%	74%
Water heater temperature adjustment	6	0.00	6	0.00	100%	100%
Mobile home weatherization	226	0.06	226	0.06	100%	100%
Total	**3,799** [a]	**0.40**	**3,761**	**0.40**	**99%**	**99%**

Note: Values rounded for reporting purposes.
a. DESC reported 3,799 ex-ante MWH to the commission but the Evaluation Team identified a small rounding error; the actual ex-ante savings is 3,800 MWH.

Net Impacts

The Evaluation Team applied a NTGR of 1.0, which is a common assumption when evaluating low-income programs; most customers are highly unlikely to install these measures or take additional action without the program due to income constraints. As a result, the ex-post net savings are identical to the ex-post gross savings of 3,761 MWH and 0.40 MW (Table 45).

Table 45. Net Impacts for NEEP

Ex-Post Gross Savings		NTGR		Ex-Post Net Savings	
MWH	MW	MWH	MW	MWH	MW
3,761	0.40	1.00	1.00	3,761	0.40

3.6 Appliance Recycling Program

3.6.1 Program Description

The Appliance Recycling Program (ARP) offers incentives to DESC residential customers who recycle less efficient, but operable, primary and secondary refrigerators and/or stand-alone freezers. In addition to the incentive, recycled appliances are picked up free-of-charge. The program generates energy savings by removing the less-efficient measures from the market so that they do not continue to operate inefficiently within DESC's service territory. The program is implemented with assistance from ARCA, Inc. and offered to active residential electric customers seeking to recycle operational appliances between 10 and 30 cubic feet. Customers receive a $50 rebate per appliance and are limited to two rebates per program year. Program marketing included monthly bill inserts, paid social media on Facebook and Instagram, news releases and ongoing "Smart Home Prize Pack" contests to help drive customer engagement. In addition, a video on "What to Expect on Pickup Day" was produced to help customers better understand the recycling process and to demonstrate our commitment as a partner with the EPA's Responsible Appliance Disposal Program (RAD).

3.6.2 Program Performance Summary

The program reported a total of 3,283 recycled appliances for 3,040 participants. The program exceeded its forecasted energy and demand savings primarily through higher average per-appliance savings compared to forecasts. Table 46. shows the program's actual versus forecasted results.

Table 46. ARP Forecasts and Results

Metric	Forecast	Actual	% of Forecast
Cost	$634,610	$680,639	107%
Participation (appliances)	3,180	3,283	103%
Gross MWH Savings	2,425	3,344	138%
Gross MW Savings	0.30	0.38	127%
Net MWH Savings	N/A	2,083	N/A
Net MW Savings	N/A	0.25	N/A

Note: Values rounded for reporting purposes

Table 47 summarizes the number of unique participants and the number of recycled appliances in PY9. The majority (85%) of participants recycled one refrigerator, while others recycled one freezer or multiple appliances. Note, the ex-ante unique participant count was 3,103, using unique order numbers instead of account numbers. Some participants had multiple order numbers in the program-tracking data, therefore, the Evaluation Team used account numbers to verify the number participants. This change resulted in a small (2%) reduction in ex-post customer counts compared to ex-ante. Note, this change did not impact measure counts.

Table 47. ARP Total Recycled Appliances and Unique Participants

Number and Type of Appliance	Total PY9 Measures	Number of Unique Participants	% of Measure Total	% of Total
1 Refrigerator	2,365	2,365	72%	78%
1 Freezer	435	435	13%	14%
1 Refrigerator & 1 Freezer	218	109	7%	4%
2 Refrigerators	230	115	7%	4%
2 Freezers	26	13	<1%	<1%
2 Refrigerators & 1 Freezer	3	1	<1%	<1%
2 Freezers & 1 Refrigerator	3	1	<1%	<1%
3 Refrigerators	3	1	<1%	<1%
Total	**3,283**	**3,040**	**100%**	**100%**

3.6.3 Impact and Data-Tracking Findings

The Evaluation Team reviewed the program-tracking database and found no duplicative records or tracking errors. The team applied the PY5-evaluated 100% verification rate to arrive at the total ex-post measure quantity. Table 48 compares the ex-ante and ex-post measure quantities.

Table 48. ARP Number of Measures Rebated

Measure Type	Ex-Ante Measure Quantity	Verification Rate	Ex-Post Measure Quantity
Refrigerator	2,710	100%	2,710
Freezer	573	100%	573
Total	**3,283**	**100%**	**3,283**

As shown in Table 49, the program achieved 3,344 MWH and 0.38 MW in ex-post gross savings. Recycled refrigerators represent the majority (87%) of program savings. The overall gross realization rate is 101% for both energy and demand savings. The driver of variation between ex-ante and ex-post gross savings is due to the mix of appliance characteristics, including; appliance age, size (i.e., cubic feet), type (i.e., single door, side-by-side, chest) and use (primary or secondary appliance). Ex-ante savings estimates used a deemed savings value based on PY8-evaluated average savings. Ex-post savings were estimated using actual PY9 recycled appliance characteristics and the Uniform Methods Projects (UMP) protocols.[4] Calculating savings based on the actually recycled appliance characteristics resulted in increased average per-appliance savings (Table 50) and, thereby, increased ex-post savings compared to ex-ante.

Table 49. ARP Ex-Post Gross Savings Summary

Measure Type	Ex-Post Quantity	Ex-Ante Gross Savings		Ex-Post Gross Savings		Gross Realization Rate	
		MWH	MW	MWH	MW	MWH	MW
Refrigerator	2,710	2,897	0.33	2,908	0.33	100%	100%
Freezer	573	423	0.05	436	0.05	103%	103%
Total	**3,283**	**3,321**	**0.38**	**3,344**	**0.38**	**101%**	**101%**

Note: Values rounded for reporting purposes.

Table 50 below compares ex-ante and ex-post per-appliance average savings.

Table 50. ARP Ex-Post Net Savings Summary

Measure Type	Ex-Ante Average Per-Appliance Savings		Ex-Post Average Per-Appliance Savings		% Difference	
	KWH	KW	KWH	KW	KWH	KW
Refrigerator	1069.15	0.122	1,072.91	0.122	<1%	0%
Freezer	738.91	0.084	760.78	0.087	3%	4%

Note: Values rounded for reporting purposes.

The Evaluation Team applied PY5-evaluated NTGRs to the PY9 ex-post gross savings values to determine ex-post net savings. As shown in Table 51, the program achieved ex-post net savings of 2,083 MWH and 0.25 MW.

[4] Source: The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. Chapter 7: Refrigerator Recycling Evaluation Protocol. https://www.nrel.gov/docs/fy17osti/68563.pdf . The part-time use adjustment was informed by PY5-evaluated data.

Table 51. ARP Ex-Post Net Savings Summary

Measure Type	Ex-Post Gross Savings		NTGR		Ex-Post Net Savings	
	MWH	MW	MWH	MW	MWH	MW
Refrigerator	2,908	0.33	0.61	0.64	1,774	0.21
Freezer	436	0.05	0.71	0.74	310	0.04
Total	**3,344**	**0.38**	**0.62**	**0.65**	**2,083**	**0.25**

Note: Values rounded for reporting purposes.

3.7 EnergyWise for Your Business Program

3.7.1 Program Description

The EnergyWise for Your Business (EWfYB) Program offers incentives to eligible Commercial and Industrial (C&I) customers in the DESC electric service area to encourage the installation of high-efficiency equipment and building improvements that reduce energy costs. The program, implemented with the support of ICF, includes both prescriptive and custom incentives. At the close of PY9, 438 large commercial and industrial accounts, representing approximately 23% of DESC's retail electric load, had opted out of DESC's DSM programs.

This report combines the prescriptive and custom program components for simplicity and because they are implemented as one program.

3.7.2 Program Performance

Table 52 shows the program's PY9 performance in comparison to the forecast. Higher average per-project MWH and MW savings led the program to exceed its energy and demand savings forecasts.

Table 52. EWfYB Forecasts and Results

Metric	Forecast	Actual	% of Forecast
Program Cost	$4,768,746	$5,184,879	108%
Participation (Projects)	690	606	88%
Gross MWH Savings	33,559	40,572	121%
Gross MW Savings	6.20	7.06	114%
Net MWH Savings	N/A	29,212	N/A
Net MW Savings	N/A	5.29	N/A

As with previous years, prescriptive lighting measures continue to drive program savings, accounting for 80% and 83% of ex-post gross energy and demand savings, respectively.

Table 53. EWfYB Savings by Project Type

Project Type	Number of Projects	Percent of Ex-Post MWH	Percent of Ex-Post MW
Prescriptive Lighting			
Prescriptive Lighting	530	80%	83%
Prescriptive New Construction Lighting	13	3%	2%
Prescriptive Non-Lighting and Custom			
Custom Incentives	17	10%	9%
Prescriptive Unitary HVAC	25	4%	4.3%
Prescriptive Chillers	6	3%	2%
Other Prescriptive Non-Lighting	15	0.6%	0.1%
Total	**606**	**100%**	**100%**

3.7.3 Impact and Data Tracking Findings

The impact evaluation involved multiple steps in quantifying ex-post gross and net savings. The first step confirmed that DESC's reported ex-ante savings to match the sum of tracked savings for each project in the database. The Evaluation Team then reviewed the program tracking database to ensure there were no duplicate records, that all PY9 projects were completed within the program year, and that there were no missing data (i.e., ex-ante savings, quantities and incentives were included in the dataset). Next, to assess any differences between current and previous program years, the Evaluation Team compared PY9 and PY8 participation, per-unit savings and other performance metrics across all measure types. Results of this comparative analysis informed the Evaluation Team's decision to use PY8 evaluation results or perform additional analysis with PY9 information. Where the Evaluation Team identified deviations from PY8 or where the implementer indicated changes to PY9 assumptions compared to the previous year, the Evaluation Team requested additional project documentation. Lastly, the Evaluation Team applied the PY8 NTGR to estimate ex-post net savings.

Database Review

The Evaluation Team did not find any tracking errors when reviewing the program tracking database and, therefore, did not adjust ex-ante savings as shown Table 54.

Table 54. EWfYB Database Review Adjustments

Application Type	Reported Ex-Ante Gross		Revised Ex-Ante Gross		Tracking Accuracy	
	MWH	MW	MWH	MW	MWH	MW
Prescriptive Lighting	31,497	6.320	31,497	6.32	100%	100%
Custom Incentives	4,145	0.64	4,145	0.64	100%	100%
Prescriptive Unitary HVAC	2,001	0.27	2,001	0.27	100%	100%
Prescriptive New Construction Lighting	1,046	0.16	1,046	0.16	100%	100%
Prescriptive Chillers	734	0.12	734	0.12	100%	100%
Other Prescriptive Non-Lighting	268	0.01	268	0.01	100%	100%
Total	**39,691**	**7.51**	**39,691**	**7.51**	**100%**	**100%**

Ex-Ante Per Unit Review

The Evaluation Team compared PY9 participation and ex-ante savings to the previous program year using the following measure metrics: total ex-ante energy and demand savings, the share of program ex-ante energy savings, per unit ex-ante energy and demand savings for each application type and total projects and measures incented. The Evaluation Team performed this review because the program applies project-specific inputs (e.g., actual reported hours of use and installed lighting wattages), which are not included in the tracking database. Table 55 shows an example of this comparison for several metrics.

Table 55. PY9 and PY8 EWfYB Comparison

Application Type	Share of Program Ex-Ante Energy Savings (KWH)		Per-Unit Ex-Ante Energy Savings (KWH)		Per-Unit KWH Percent Difference
	PY8	PY9	PY8	PY9	
Prescriptive Lighting	78.9%	79.4%	202	207	3%
Custom Incentives	11.9%	10.4%	266,225	243,828	-8%
Prescriptive Unitary HVAC	2.4%	5.0%	5,674	11,372	100%[a]
Prescriptive New Construction Lighting	4.3%	2.6%	100,880	80,437	-20%
Prescriptive Chillers	1.3%	1.9%	78,964	122,394	55%
Other Prescriptive Non-Lighting	1.1%	0.7%	681	467	-32%

a. The 100% increase in Unitary HVAC per unit savings is the result of a single large project installing 28 measures at 40,415 KWH per measures, accounting for 57% of Prescriptive Unitary HVAC savings. The per unit savings are in line with the similar projects from PY8 and PY9.

The evaluation team found similar measure metrics for all application types with two exceptions:

- For Prescriptive Unitary HVAC projects, average per-unit ex-ante energy savings for PY9 is approximately double PY8 per-unit savings, and
- For Prescriptive Chiller projects, the average per-unit ex-ante energy savings for PY9 is 55% greater than PY8 per unit savings.

For all other measure types, the evaluation team observed no notable differences in planning assumptions, measure mix, or per-unit savings.

Unitary HVAC and Chiller Projects

In the PY8 evaluation, the Evaluation Team observed that Chiller and Unitary HVAC measure assumptions did not align with DESC's 2018 Commercial Energy Algorithm Manual (CEAM) and recommended that Program Administrators align assumptions to the 2019 CEAM in PY9. Through discussions with DESC staff and the ICF Implementation Team, the Evaluation Team confirmed that the planning assumptions for PY9 were updated to align with the 2019 CEAM for projects with an application date of November 4, 2018 or later. The evaluation team received the following information on the timing of updates with respect to project applications:

- The eleven PY9 projects having application start dates **before** November 4, 2018 used the same baseline efficiency values in ex-ante estimates as PY8 measures.
- For the twenty PY9 Unitary HVAC and Chiller projects with an application start date **after** November 4, 2018, ex-ante savings estimates were calculated using the updated baseline efficiency values to align with the evaluation team's PY8 recommendations, and 2019 CEAM updated values.

The Evaluation Team requested PY9 project documentation for unitary HVAC and chiller projects and confirmed ex-ante assumptions aligned with the 2019 CEAM in the projects with application start dates after November 4, 2018.

Gross Verified Savings

Based on our findings from the PY8 and PY9 comparison, updates to PY8 planning assumptions for Unitary HVAC and Chiller measures and additional desk reviews of Unitary HVAC and Chillers projects, the Evaluation Team determined the following approach to quantify ex-post gross savings for the PY9 EWfYB measures:

- For Unitary HVAC and Chiller projects with application start dates before November 4, 2018, the Evaluation Team applied the unadjusted PY8 energy and demand realization rates.
- For Unitary HVAC and Chiller projects with application start dates after November 4, 2018, the Evaluation Team applied adjusted PY8 energy and demand realization rates of 100% for both project types (described in Appendix C). These adjusted realization rates take into account the changes in unit baseline efficiencies in the estimation of ex-ante savings.
- For all other application types, the Evaluation Team applied PY8 realization rates.

The Evaluation Team provides additional details about this approach in Appendix B

Resulting values are presented in Table 56. Overall, the EWfYB Program achieved gross realization rates of 102% for energy, indicating that the evaluated ex-post savings exceeded the ex-ante estimate. This result is driven primarily by the 103% energy realization rate calculated for the PY8 Prescriptive Lighting measures.

The program ex-post demand savings were lower than the ex-ante estimates with a realization rate of 94%. This result is driven by the 93% demand realization rate calculated for the PY8 Prescriptive Lighting measures.

Table 56. EWfYB Ex-Post Gross Savings Summary

Application Type	Ex-Ante		Ex-Post		Gross RR	
	MWH	MW	MWH	MW	MWH	MW
Prescriptive Lighting	31,497	6.32	32,370	5.85	103%	93%
Custom Incentives	4,145	0.64	4,094	0.66	99%	103%
Prescriptive Unitary HVAC [a]	2,001	0.27	1,525	0.30	76%	114%
Prescriptive New Construction Lighting	1,046	0.16	1,063	0.12	102%	74%
Prescriptive Chillers [a]	734	0.12	1,267	0.12	173%	101%
Other Prescriptive Non-Lighting	268	0.01	253	0.01	94%	100%
Total	**39,691**	**7.51**	**40,572**	**7.06**	**102%**	**94%**

Note: Some values in this table do not sum or divide exactly due to rounding.
[a] Gross realization rates represent the sum of ex-post savings over ex-ante savings resulting from the application of unadjusted PY8 realization rates to ex-ante savings for projects with application start dates before November 4, 2018 and adjusted PY8 realizations for projects with application start dates after.

Net Verified Savings

Table 57 shows the ex-post net energy and demand savings that the program achieved in PY9. The NTGR used for all projects is the value used in PY9 program planning and has been used in the evaluation since PY3.

Table 57. EWfYB Ex-Post Net Savings Summary

Ex-Post Gross Savings		NTGR		Ex-Post Net Savings	
MWH	MW	MWH	MW	MWH	MW
40,572	7.06	0.72	0.75	29,212	5.29

3.8 Small Business Energy Solutions

3.8.1 Program Description

DESC created the Small Business Energy Solutions (SBES) Program to serve a market that was underserved in the EWfYB Program. SBES participation is restricted to small businesses or nonprofits who have five or fewer DESC electric accounts and annual energy usage of less than 350,000 KWH.

The program offers a no-cost on-site energy audit and incentives for lighting and refrigeration equipment. While the SBES Program offers fewer measures than EWfYB, the financial incentives offered are higher to help overcome cost barriers often faced by small businesses. SBES covers up to 80% of the pre-tax project costs of energy-efficient equipment pursued through the program, not to exceed $6,000 per utility account per program year.

ICF administers the program and sub-contracts to Facility Solutions Group (FSG) for lighting measures and National Resource Management (NRM) for refrigeration measures. ICF, FSG and NRM use local service providers, or contractors, to perform installations.

3.8.2 Program Performance

Table 58 shows the program's PY9 performance in comparison to the forecast. The PY9 program exceeded all forecasts.

Table 58. SBES Forecasts and Results

Metric	Forecast	Actual	% of Forecast
Cost	$2,732,047	$3,225,894	118%
Participation (Projects)	674	781	116%
Gross MWH Savings	5,551	7,551	136%
Gross MW Savings	1.88	2.65	141%
Net MWH Savings	n/a	7,211	n/a
Net MW Savings	n/a	2.60	n/a

Participant Overview

The majority (92%) of ex-ante energy savings come from lighting projects, while refrigeration measures account for the remaining 8% of energy savings. More than eleven types of business segments participated in the program. The highest contributing segments to lighting savings were retail, offices and industrial processing (68% of ex-ante lighting energy savings). The highest contributing segment to savings for refrigeration measures was retail establishments (88% of ex-ante refrigeration energy savings). Table 59 lists each segment with associated participation levels and savings.

Table 59. SBES Participation and Savings by Segment

Segment	Number of Projects	Ex-Ante Savings		% Ex-Ante Savings	
		MWH	MW	MWH	MW
Lighting	**734**	**6,913**	**1.80**	**92%**	**98%**
Retail	291	2,560	0.73	34%	40%
Office	162	1,498	0.37	20%	20%
Industrial Processing	62	665	0.17	9%	9%
Health Facility	46	526	0.14	7%	7%
Other	44	427	0.12	6%	6%
Warehouse	44	381	0.09	5%	5%
Religious Facility	33	351	0.09	5%	5%
Restaurant	29	256	0.06	3%	3%
Grocery	11	114	0.02	2%	1%
School	7	102	0.02	1%	1%
Lodging	3	22	0.00	0%	0%
Multifamily	2	13	0.00	0%	0%
Refrigeration	**54**	**627**	**0.04**	**8%**	**2%**
Retail	44	551	0.03	7%	2%
Restaurant	8	53	0.00	1%	0%
Grocery	2	23	0.00	0%	0%
Grand Total	**781** [a]	**7,540**	**1.83**	**100%**	**100%**

Note: Some values in this table do not sum or divide exactly due to rounding.
a. Numbers do not total to 781 projects because some projects included both lighting and refrigeration measures

3.8.3 Impact and Data-Tracking Findings

The SBES evaluation included multiple steps to estimate ex-post savings, identical to those detailed above in the EWfYB Program section.

Database Review

The Evaluation Team reviewed the program tracking database and found no duplicative records or tracking errors. Thus, no adjustments to ex-ante measure quantities were needed as shown in Table 60.

Table 60. SBES Database Review Adjustments

Measure Category	Ex-Ante Gross		Revised Ex-Ante Gross		Tracking Accuracy	
	MWH	MW	MWH	MW	MWH	MW
Lighting	6,913	1.80	6,913	1.80	100%	100%
Refrigeration	627	0.04	627	0.04	100%	100%
Total	**7,540**	**1.83**	**7,540**	**1.83**	**100%**	**100%**

Note: Some values in this table do not sum or divide exactly due to rounding.

Ex-Ante Per Unit Review

The Evaluation Team performed an ex-ante per unit review of PY9 SBES Program measures to compare PY9 and PY8 measure metrics including total ex-ante energy and demand savings, share of ex-ante program savings, per unit savings for each application type and total projects and measures incented. The Evaluation Team performs this review because the program applies project-specific inputs (e.g., actual reported hours of use, installed lighting wattages, etc.), which are not included in the tracking database. Results of the per-measure review are shown in Table 61.

Table 61. PY9 and PY8 SBES Per Unit Comparison

PY9 Catalog Name	Share of Program Savings		Per Unit Energy Savings (KWH)		Per Unit KWH Percent Difference
	PY8	PY9	PY8	PY9	
LED Linear	63.8%	23.5%	244	248	-2%
LED Fixture [a]	9.0%	N/A	284	N/A	N/A
LED Exterior Lights	8.3%	15.5%	976	846	15%
LED Screw-ins	4.6%	9.3%	118	104	13%
Other controls & EC Motors	3.1%	5.2%	715	600	19%
LED Case Lights	3.1%	2.4%	479	651	-26%
Evaporative/Compressor Controls	3.1%	5.9%	4,347	4,699	-7%
Cooler Door Heater Controls	2.1%	6.6%	8,487	8,199	4%
Fluorescent	1.6%	29.7%	522	252	107%
Abandoned Fluorescent	0.9%	1.0%	438	431	2%
LED Exit Sign	0.3%	0.7%	145	152	-4%
Abandoned HID	0.1%	0.2%	1,217	1,184	3%
Occupancy Sensor [a]	0.0%	N/A	127	N/A	N/A
Freezer door heater controls	0.0%	0.0%	610	983	-38%

[a] Catalog names not seen in PY8.

The Program Administrators confirmed that LED Fixture offerings were introduced mid-year 2018 and likely resulted in the decreases seen in the program savings share of Fluorescent offerings. Since the program administrators confirmed no other changes in the PY9 program savings calculation methods compared to PY8 and the PY9 measure mix and per unit savings are similar to PY8, the Evaluation Team estimated ex-post gross savings for PY9 by applying the evaluated PY8 realization rates. The final ex-post gross results and realization rates for PY9 are shown in Table 62.

Table 62. SBES Ex-Post Gross Savings Summary

Measure Category	Ex-Ante		Ex-Post		Gross RR	
	MWH	MW	MWH	MW	MWH	MW
Lighting	6,913	1.80	6,925	2.61	100%	145%
Refrigeration	627	0.04	626	0.04	100%	116%
Total	**7,540**	**1.83**	**7,551**	**2.65**	**100%**	**145%**

Note: Some values in this table do not sum or divide exactly due to rounding.

Net Savings

As shown in Table 63, the SBES Program achieved 7,211 MWH and 2.60 MW in ex-post net savings. To arrive at ex-post net savings, the Evaluation Team applied PY5-evaluated NTGRs for lighting and PY8-evaluated NTGRs for refrigeration to ex-post gross savings.

Table 63. SBES Ex-Post Net Savings Summary

Measure Category	Ex-Post Gross Savings		NTGR		Ex-Post Net Savings	
	MWH	MW	MWH	MW	MWH	MW
Lighting	6,925	2.61	0.96	0.98	6,648	2.56
Refrigeration	626	0.04	0.90	0.89	563	0.04
Total	**7,551**	**2.65**	**0.96**	**0.98**	**7,211**	**2.60**

Appendix A. ENERGY STAR® Lighting Detailed Methods

This appendix provides additional information on the evaluation methods for the ENERGY STAR® Lighting Program. It begins with a discussion of the methods for developing deemed savings values for new lighting and non-lighting products in PY9. Next, this appendix provides a summary of the substantive differences (i.e., non-rounding issues) between ex-ante and ex-post deemed savings for new products as well as three existing products that received corrections. This is followed by a comparison of total ex-ante and revised gross savings for all product types[5] in the program. This section concludes with detail on the carryover of savings from previous program years.

Evaluation of New Products

In PY9, the Evaluation Team evaluated per-unit savings for 17 new LED lighting products and ten new water-saving products (showerheads, faucet aerators, and thermostatic shower valves).

New Lighting Products Deemed Savings Estimation

Equation 1 and Equation 2 provide the formulas the team used to estimate per-unit energy and demand savings for new lighting products.

Equation 1. Lighting Revised Gross Energy Savings Formula

$$KWh\ Savings = (HOU \times 365) \times (W_{Base} - W_{Eff}) \times WHFe/1000$$

Equation 2. Lighting Revised Gross Demand Savings Formula

$$KW\ Savings = (W_{Baseline} - W_{Eff}) \times WHFd \times CF/1000$$

Where:

$KWh\ Savings$ = first-year energy savings
$KW\ Savings$ = first-year peak demand savings
HOU = Average hours of use per day
W_{Base} = Baseline wattage
W_{Eff} = Wattage of the energy-efficient replacement
$WHFe$ = Waste heat factor for energy use, accounts for the effects of more efficient lighting on cooling energy use
$WHFd$ = Waste heat factor for demand, accounts for the effects of more efficient lighting on cooling energy demand
CF = Coincidence factor

Baseline Wattage

Traditionally, the baseline wattage for energy-efficient products has been an incandescent light bulb. However, the provisions of the 2007 EISA rulings have gradually increased the efficiency requirements of general service incandescent light bulbs. The regulations phased in over several years, affecting 100-watt general service incandescent bulbs in January 2012, 75-watt incandescent bulbs in January 2013, and 60-watt and 40-watt incandescent bulbs in January 2014. Manufacturers responded to EISA by developing halogen bulbs that meet

[5] Note, one "product type" may contain multiple "products" (defined by measure ID), such as different brands of the same type and wattage of LED.

the new efficiency standards. These new "EISA-compliant" halogens ultimately replaced incandescent lamps as the efficient baseline for calculating program savings; affected incandescent lamp wattages are now assumed to be virtually non-existent on store shelves. A second phase of the legislation was set to take effect on January 1, 2020, setting an efficiency standard of 45 lumens per watt across nearly all screw-based products commonly used in residential applications. However, through a series of rules and determinations issued throughout 2019, the DOE effectively rolled back the enactment of these standards.

The Evaluation Team cross-referenced product descriptions with assigned wattages, baseline wattages and lumen ranges, then assigned final baseline wattages based on verified lumen counts. Table 64 provides the post-EISA 2007 baseline wattage by lumen range that the Evaluation Team applied for new standard products.

Table 64. ENERGY STAR® Lighting Program: Baseline Wattages for Standard Bulbs

Lumen Range	Incandescent-Equivalent Wattage	Post-EISA Baseline Wattage
250–309	<40	25
310–749	40	29
750–1,049	60	43
1,050–1,489	75	53
1,490–2,600	100	72
2,601–2,999	150	150
3,000–5,279	200	200
5,280–6,209	300	300

In addition to general service products, certain directional lighting products (i.e., "reflectors") are subject to Department of Energy (DOE) energy efficiency standards that went into effect at the beginning of 2012.[6] The legislation affected directional LEDs depending on the bulb type and lumen range. As a result, the Evaluation Team applied the following baseline wattages for new directional LED products.

Table 65. ENERGY STAR® Lighting Program: Baseline Wattages for Directional Bulbs

Reflector Bulb Type	Lumen Range	Reflector Bulb Baseline Wattage
R, PAR, ER, BR, BPAR, or similar bulb shapes with medium screw bases and diameter >2.5"	600-849	50
	850-999	55
	1,000-1,300	65
ER30, BR30, BR40, ER40	400-449	40
	450-499	45
	500-1,419	65
R40	400-449	40
	450-719	45
All reflector lamps below the lumen ranges specified above	200-299	30
	300-399	40

[6] Department of Energy. 10 CFR 430 Energy Conservation Program: Energy Conservation Standards and Test Procedures for General Service Fluorescent Lamps and Incandescent Reflector Lamps: Final Rule. July 2009.

Products exempt from both EISA and DOE legislation were assigned an incandescent baseline wattage based on verified lumen counts.

Efficient Product Wattage

The Evaluation Team used actual wattages of the new lighting products as specified by product manufacturers. The Evaluation Team performed internet lookups for a small number of newly introduced lighting products with inconsistent per-unit savings or inconclusive measures descriptions recorded in program-tracking data.

Hours of Use and Coincidence Factor

The Evaluation Team used PY2-evaluated assumptions of 3.0 daily hours of use and a 0.10 coincidence factor.

Waste Heat Factors

The inclusion of waste heat factors for lighting is based on the concept that heating loads increase to supplement the reduction in heat that was once provided by incandescent lamps and cooling loads decrease since there is less heat output from the incandescent lamp that was once in place. The overall effects are complicated to determine, as they are influenced not just by the type of lighting used, but also by the climate and the type of HVAC systems used to heat and cool the home. Waste heat factors developed for one climate region cannot be used in another; the climate and the mix of heating and cooling use vary widely across the country. DESC currently does not have waste heat factor estimates that are specific to its territory and fuel mix. The Evaluation Team, therefore, used an energy and demand waste heat factor of 1.0.

New Non-Lighting Product Deemed Savings Estimation

The new non-lighting products in PY9 were faucet aerators (1.0 GPM or 1.5 GPM), 1.5 GPM showerheads, shower thermostatic valves (TSV) and a combination of a showerhead and a shower TSV. To determine deemed savings for these measures, the Evaluation Team used a combination of assumptions from the Illinois (IL) and Indiana (ID) Technical Reference Manuals (TRMs), survey data from the DESC Market Potential Study and South Carolina-specific temperature assumptions from the National Renewable Energy Lab (NREL). Table 66 summarizes the revised deemed savings values for new non-lighting measures sold through the Online Store channel. Table 67, through Table 69, detail the algorithms and assumptions for the new non-lighting measures.

Table 66. Online Store: New PY9 Non-Lighting Measures Revised Deemed Savings

Measure	KWH Savings Per Unit	KW Savings Per Unit
Faucet Aerator (1.0 GPM)	29.01	0.0021
Faucet Aerator (1.5 GPM)	13.28	0.0010
Showerhead (1.5 GPM)	158.65	0.0086
Showerhead (1.5 GPM w/ TSV)	190.59 [a]	0.0154 [a]
TSV	50.05	0.0068

a. The deemed savings for Showerhead (1.5 GPM w/ TSV) is the sum of the individual deemed savings values for Showerhead (1.5 GPM) and a TSV on a 1.5 GPM showerhead (i.e., the GPM of the new, efficient showerhead). This TSV savings is lower than the savings for the TSV-only measure, which assumes the TSV was placed on a 2.35 GPM standard showerhead).

Table 67. Online Store Faucet Aerators Savings Algorithms and Assumptions

Faucet Aerator Savings (Online Store)		
Algorithms		
KWH Savings	= (((Baseline GPM * Baseline Throttling Factor - Efficient GPM * Efficient Throttling Factor)*(Minutes/Person/Day))* (People/Household) * 365.25 * DF / (Faucets/Household))* (8.33 * (Tmix-Tinlet))/(RE * 3,412) * %Elec WH	
KW Savings	= KWH Savings / Hours * CF	
Parameter	**Assumption**	**Source and notes**
Baseline GPM	2.20	Use actual if available, otherwise assume 2.20 GPM from IL TRM V8.0
Efficient GPM	1.00 or 1.50	Use actual, if available.
Baseline Throttling Factor	0.83	IL TRM V8.0
Efficient Throttling Factor	0.95	IL TRM V8.0
Minutes/Person/Day	2.36	IL TRM V8.0.
People/Household	2.45	Average people/household determined through participant surveys of similar programs within North Carolina and South Carolina jurisdictions.
Faucets/Household	2.35	IL TRM v8. Based on findings from a 2009 ComEd residential survey of 140 sites, provided by Cadmus.
Mixed Water Temperature (Tmix °F)	87.83	IL TRM v8.0
Supply Water Temperature (Tinlet °F)	69.11	NREL Domestic Hot Water Event Generator calculator Columbia, SC.
Recovery Efficiency (RE)	0.98	Recovery efficiency for standard electric resistance water heaters (consistent assumption across Illinois TRM, Indiana TRM, Arkansas TRM).
Hours	23.75	Calculated using the following formula: (Minutes/Person/Day) * (People/Household) / (Fixtures/Household) / 60 * 365.25
Coincidence Factor (CF)	0.002	IN TRM V2.2. Based on Wisconsin TRM, which has a peak period that spans 12 hours like that of DESC (10 AM - 10 PM).
Drain Factor (DF)	86%	IL TRM v8. This represents the portion of the water that flows directly down the drain and is not collected for another purpose. If the water is collected, it will not save any energy, as the volume is constant regardless of the flow rate.
Electric Water Heating Fuel Weight (%Elec WH)	92%	Water heating fuel types are unknown for Residential Lighting participants and therefore rely on results from the 2019 DESC Potential Market Study.
In-Service Rate (ISR)	100%	Placeholder pending program-specific participant survey in future evaluation. Will likely be less than 100%.

Table 68. Online Store Showerhead Savings Algorithms and Assumptions

Showerhead Savings (Online Store)		
Algorithms		
KWH Savings	= (Baseline GPMbase - Efficient GPM) * (Showers/Person/Day) * (Minutes/Person/Shower) * (People/Household) / (Showers Fixtures/Household) * 365.25 * (Tmix - Tinlet) * 8.33 / (3,412 * RE) * %Elec WH	
KW Savings	= KWH Savings / Hours * CF	
Parameter	**Assumption**	**Source and notes**
Baseline GPM	2.35	Use actual GPM from program database if available; otherwise, rely on Time-of-Sale values for the Residential Lighting Program from the IL TRM V8.0.
Efficient GPM	1.50	Use actual, if available.
Showers/Person/Day	0.60	IL TRM v8.0
Minutes/Person/Shower	7.80	IL TRM v8.0
People/Household	2.45	Average people/household determined through participant surveys of similar programs within North Carolina and South Carolina jurisdictions.
Shower Fixtures/Household	1.64	Home types are unknown for Residential Lighting participants and therefore rely on the default value for "unknown" home type from the IL TRM V8.0.
Mixed Water Temperature (Tmix °F)	101.00	IL TRM V8.0.
Supply Water Temperature (Tinlet °F)	69.11	NREL Domestic Hot Water Event Generator calculator Columbia, SC.
Recovery Efficiency (RE)	0.98	Recovery efficiency for standard electric resistance water heaters (consistent assumption across Illinois TRM, Indiana TRM, Arkansas TRM).
Hours	42.56	Calculated using the following formula: (Showers/Person/Day) * (Minutes/Person/Shower) * (People/Household) / (Shower Fixtures/Household) / 60 * 365.25
CF	0.002	IN TRM V2.2. Based on Wisconsin TRM, which has a peak period that spans 12 hours like that of DESC (10 AM - 10 PM).
Electric Water Heating Fuel Weight (%Elec WH)	92%	Water heating fuel types are unknown for Residential Lighting participants and therefore rely on results from the 2019 DESC Potential Market Study.
In-Service Rate (ISR)	100%	Placeholder pending program-specific participant survey. Will likely be less than 100%.

Table 69. Online Store Shower TSV Savings Algorithms and Assumptions

Shower TSV Savings (Online Store)		
Algorithms		
KWH Savings	= (GPM*HWWT*(People/Household)*(Showers/Person/Day) * 365.25/(Showers Fixtures/Household)*(8.33*(Tmix-Tinlet)/(RE * 3,412)*%Elec WH	
KW Savings	= KWH Savings / Hours * CF	
Parameter	**Assumption**	**Source and notes**
GPM (w/o low-flow showerhead)	2.35	Use actual GPM from program database if available; otherwise, rely on Time-of-Sale values for the Residential Lighting Program from the IL TRM V8.0.
GPM (w/ low-flow showerhead)[a]	1.50	Actual flow rate of low-flow showerheads offered Residential Lighting Program.
Hot Water Waste Time (HWWT)	0.89	IL TRM V8.0.
People/Household	2.45	Average people/household determined through participant surveys of similar programs within North Carolina and South Carolina jurisdictions.
Shower Fixtures/Household (unknown home type)	1.64	Home types are unknown for Residential Lighting participants and therefore rely on the default value for "unknown" home type from the IL TRM V8.0.
Showers/Person/Day	0.60	IL TRM v8.0
Mixed Water Temperature (Tmix °F)	101.00	IL TRM V8.0.
Supply Water Temperature (Tinlet °F)	69.11	NREL Domestic Hot Water Event Generator calculator Columbia, SC.
Recovery Efficiency (RE)	0.98	Recovery efficiency for standard electric resistance water heaters (consistent assumption across Illinois TRM, Indiana TRM, Arkansas TRM).
Electric Water Heating Fuel Weight (%Elec WH)	92%	Water heating fuel types are unknown for Residential Lighting participants and therefore rely on results from the 2019 DESC Potential Market Study.
In-Service Rate (ISR)	100%	Placeholder pending program-specific participant survey. Will likely be less than 100%.
Hours (w/o low-flow showerhead)	17.03	Calculated using the formula from Mid-Atlantic TRM V9.0
Hours (w/ low-flow showerhead)	10.87	Calculated using the formula from Mid-Atlantic TRM V9.0
Coincidence Factor (CF)	0.002	IN TRM V2.2. Based on Wisconsin TRM, which has a peak period that spans 12 hours like that of DESC (10 AM - 10 PM).

a. A 2.35 GPM assumption is appropriate when the TSV is installed in combination with a low-flow showerhead.

Revised Deemed Savings Assumption Summary

Table 70 provides a list of products for which the Evaluation Team made substantive (i.e., non-rounding) deemed per-unit savings revisions compared to ex-ante; all of these products are part of the Online Store channel. This list includes the 27 new products and three existing products.

Table 70. ENERGY STAR® Lighting Program: Deemed Savings Revisions

Measure ID	Product	Ex-Ante Per-Unit Savings		Revised Gross Per-Unit Savings	
		KWH	KW	KWH	KW
Existing products: Corrected deemed savings value					
R1160.9865	Reflector LED (BR20) (7W)	36.14	0.003	47.09	0.004
R2070.209	Smart LED (BR30) (8W)	60.77	0.006	56.94	0.005
R7005.616	Advanced power strip - Tier 1 (4-outlet)	102.8	0.01	56.50	0.006
New products: Evaluated deemed per-unit savings for the first time					
R1100.667	Standard LED (6W)	25.19	0.002	25.19	0.002
R2010.304	Standard LED (11W)	36.14	0.003	35.04	0.003
R2040.457	Reflector LED (BR30) (7W)	60.77	0.006	63.51	0.006
R2040.101	Reflector LED (BR30) (9W)	60.23	0.006	61.32	0.006
R2040.1021	Reflector LED (R20) (7W)	36.14	0.003	47.09	0.004
R2040.901_2	Reflector LED (PAR38) (10.5W)	105.12	0.01	59.68	0.006
R2040.901	Reflector LED (PAR38) (10.5W)	52.56	0.005	59.68	0.006
R2300.601	Reflector LED (PAR38) (15W)	52.56	0.005	54.75	0.005
R2030.201	Decorative LED (4.5W)	23.54	0.002	38.87	0.004
R2030.102	Decorative LED (5W)	26.28	0.002	26.28	0.002
R1100.5393	Decorative LED (5W)	38.33	0.004	38.33	0.004
R2060.305	Decorative LED (6.5W)	38.33	0.004	36.68	0.003
R2060.103F_12	Decorative LED (7.5W)	37.23	0.003	57.49	0.005
R2060.841	Decorative LED (8W)	37.23	0.003	56.94	0.005
R2020.158	Globe LED (7W)	38.33	0.004	36.14	0.003
R1000.721	Linear LED (7W)	27.38	0.003	27.38	0.003
R1000.922	Linear LED (10W)	24.09	0.002	24.09	0.002
R3000.531	Shower thermostatic valve (TSV)	279.00	0.03	50.05	0.0068
R3000.5324	Showerhead (1.5 GPM with TSV)	279.00	0.03	190.59	0.0154
R3000.5325	Showerhead (1.5 GPM with TSV)	279.00	0.03	190.59	0.0154
R3000.943	Showerhead (1.5 GPM)	279.00	0.03	158.65	0.0086
R3000.172	Showerhead (1.5 GPM)	279.00	0.03	158.65	0.0086
R3010.03	Faucet Aerator (1.0 GPM)	225.00	0.01	29.01	0.0021
R3010.31	Faucet Aerator (1.5 GPM)	225.00	0.01	13.28	0.0010
SAVERKIT.DL	Energy Saver kit (Decorative)	666.75	0.06	669.65	0.062
SAVERKIT.OL	Energy Saver kit (Outdoor)	628.53	0.05	647.69	0.054
SAVERKIT.RL	Energy Saver kit (Recessed)	776.25	0.07	781.90	0.072

The key reasons for differences between ex-ante and ex-post deemed savings values are as follows.

- **Lighting Products:** For the two existing lighting products, ex-ante savings applied the incorrect deemed savings value. For the 17 new lighting products, ex-ante applied placeholder values, generally from similar products and the Evaluation Team developed an ex-post deemed savings for the first time. The

ex-post deemed savings values use different baseline and/or efficient wattage assumptions, leading to higher or lower ex-post savings depending on the product.

- **Advanced power strip – Tier 1 (4-outlet):** For this existing product, ex-ante incorrectly applied the deemed savings value for 7-outlet or 12-outlets advanced power strips. Ex-post applied the correct deemed savings value, reducing ex-post savings compared to ex-ante.
- **Faucet Aerators:** These were new products in PY9. Ex-ante savings used a PY7-evaluated savings assumption specifically for a 1.5 GPM kitchen faucet aerator that is directly installed in a home with electric water heating; this is the same savings value that DESC uses for the HEC Program. The ex-post deemed savings for Online Store differs in two respects that are more appropriate for an online purchase: 1) they assume unknown location, which is a blend of kitchen and bathroom aerator deemed savings values (bathroom aerators save much less energy compared to kitchen aerators); and 2) the ex-post savings value assumes that 92% of customers have electric water heating, rather than 100%, based on survey results from the 2019 DESC Market Potential Study. Both of these adjustments reduced ex-post savings compared to ex-ante. More detail on the assumption the team used to develop water-saving product savings is available in the previous section of this appendix.
- **Showerheads and Shower TSV:** These were new products in PY9. Ex-ante savings applied the same placeholder values of 279 KWH and 0.03 KW for three product types: 1.5 GPM showerheads, shower TSVs, and 1.5 GPM showerheads plus shower TSVs. The Evaluation Team estimated ex-post deemed savings values for these products using assumptions from the IL and IN TRMs, survey data from the DESC Market Potential Study, as well as South Carolina-specific temperature assumptions from the NREL. The team also developed different savings values for the three product types, whereas ex-ante applied the same value. The new deemed savings values reduced ex-post savings compared to ex-ante. More detail on the assumptions the team used to develop water-saving product savings is available in the previous section of this appendix.

Ex-Ante and Revised Gross Savings Comparison by Product Type

Table 71 summarizes ex-ante gross savings, revised gross savings, and the gross savings realization rates before applying ISRs for all product types in the ENERGY STAR® Lighting Program. Note, aside from the products listed in Table 70 above, differences between ex-ante and revised gross savings reflect minor rounding issues only.

Table 71. ENERGY STAR® Lighting Program Gross Savings by Channel and Product Type

Program Channel	Product Type	Wattage	Verified Units Sold	Ex-Ante Total Savings		Revised Gross Total Savings		Gross Savings Realization Rate (Before ISR)	
				KWH	KW	KWH	KW	KWH	KW
Online Store	Standard LED	6	1,166	29,372	2.33	29,366	2.68	100%	115%
Online Store	Standard LED	7.5	297	11,544	1.19	11,545	1.05	100%	89%
Online Store	Standard LED	9	143,805	5,353,860	431.42	5,353,860	488.94	100%	113%
Online Store	Standard LED	9.5	179	6,566	0.54	6,566	0.60	100%	112%
Online Store	Standard LED	11	522	18,865	1.57	18,291	1.67	97%	107%
Online Store	Standard LED	14	24	1,025	0.10	1,025	0.09	100%	98%
Online Store	Standard LED	18	625	36,956	3.12	36,956	3.38	100%	108%
Online Store	Reflector LED (BR20)	7	150	5,421	0.45	7,063	0.65	130%	143%
Online Store	Reflector LED (BR30)	7	35	2,127	0.21	2,223	0.20	105%	97%
Online Store	Reflector LED (BR30)	9	507	30,537	3.04	31,089	2.84	102%	93%
Online Store	Reflector LED (BR30)	10	3,906	235,258	23.44	235,239	21.48	100%	92%
Online Store	Reflector LED (BR30)	12	951	55,196	4.76	55,191	5.04	100%	106%
Online Store	Reflector LED (BR40)	9	455	27,901	2.73	27,901	2.55	100%	93%
Online Store	Reflector LED (R20)	6	38	1,831	0.15	1,831	0.17	100%	110%

Program Channel	Product Type	Wattage	Verified Units Sold	Ex-Ante Total Savings		Revised Gross Total Savings		Gross Savings Realization Rate (Before ISR)	
				KWH	KW	KWH	KW	KWH	KW
Online Store	Reflector LED (R20)	7	73	2,638	0.22	3,437	0.31	130%	143%
Online Store	Reflector LED (R30)	9.5	501	30,446	3.01	30,447	2.78	100%	93%
Online Store	Reflector LED (PAR38)	10.5	613	38,842	3.70	36,582	3.34	94%	90%
Online Store	Reflector LED (PAR38)	15	1,073	56,397	5.36	58,747	5.36	104%	100%
Online Store	3-way LED	18	694	31,917	2.78	31,917	2.91	100%	105%
Online Store	Decorative LED	3.5	474	11,158	0.95	11,159	1.02	100%	108%
Online Store	Decorative LED	4	765	30,156	3.06	30,156	2.75	100%	90%
Online Store	Decorative LED	4.5	1,068	38,679	3.83	39,601	3.62	102%	94%
Online Store	Decorative LED	5	2,821	99,971	9.93	99,960	9.13	100%	92%
Online Store	Decorative LED	6.5	353	13,530	1.41	12,949	1.18	96%	84%
Online Store	Decorative LED	7	69	2,720	0.28	2,720	0.25	100%	90%
Online Store	Decorative LED	7.5	2,316	86,225	6.95	133,141	12.16	154%	175%
Online Store	Decorative LED	8	152	5,659	0.46	8,655	0.79	153%	173%
Online Store	Globe LED	5	529	20,277	2.12	20,274	1.85	100%	87%

Program Channel	Product Type	Wattage	Verified Units Sold	Ex-Ante Total Savings		Revised Gross Total Savings		Gross Savings Realization Rate (Before ISR)	
				KWH	KW	KWH	KW	KWH	KW
Online Store	Globe LED	7	174	6,669	0.70	6,287	0.57	94%	83%
Online Store	Globe LED	7.5	260	14,947	1.30	14,947	1.37	100%	105%
Online Store	Globe LED	10	167	9,143	0.84	9,143	0.84	100%	100%
Online Store	Linear LED	7	174	4,764	0.52	4,763	0.44	100%	83%
Online Store	Linear LED	10	524	12,623	1.05	12,623	1.15	100%	110%
Online Store	Downlight LED Fixture	10	29	1,588	0.15	1,588	0.15	100%	100%
Online Store	Downlight LED Fixture	11	71	5,753	0.50	5,753	0.53	100%	106%
Online Store	Downlight LED Fixture	14	158	7,958	0.79	7,958	0.73	100%	92%
Online Store	Smart LED (A-Line)	9	24	867	0.07	894	0.08	103%	113%
Online Store	Smart LED (A-Line)	10	21	759	0.06	759	0.07	100%	110%
Online Store	Smart LED (BR30)	8	2	122	0.01	114	0.01	94%	87%
Online Store	Advanced power strip - Tier 1 (4-outlet)	N/A	87	8,944	1.04	4,916	0.55	55%	53%
Online Store	Advanced power strip - Tier 1 (7-outlet)	N/A	1,093	112,360	13.12	112,579	12.63	100%	96%
Online Store	Advanced power strip - Tier 1 (12-outlet)	N/A	357	36,700	4.28	36,771	4.13	100%	96%

Program Channel	Product Type	Wattage	Verified Units Sold	Ex-Ante Total Savings		Revised Gross Total Savings		Gross Savings Realization Rate (Before ISR)	
				KWH	KW	KWH	KW	KWH	KW
Online Store	Shower thermostatic valve	N/A	2	558	0.06	100	0.01	18%	23%
Online Store	Showerhead (1.5 GPM with thermostatic valve)	N/A	8	2,232	0.24	1,525	0.12	68%	51%
Online Store	Showerhead (1.5 GPM)	N/A	8	2,232	0.24	1,269	0.07	57%	29%
Online Store	Faucet aerator (1.0gpm)	N/A	12	2,700	0.12	348	0.03	13%	21%
Online Store	Faucet aerator (1.5gpm)	N/A	2	450	0.02	27	0.00	6%	10%
Online Store	Energy Saver kit (decorative)	N/A	7,232	301,371	28.02	305,360	28.27	101%	101%
Online Store	Energy Saver kit (outdoor)	N/A	3,510	147,076	12.64	151,559	12.64	103%	100%
Online Store	Energy Saver kit (recessed)	N/A	6,992	339,221	31.46	341,690	31.46	101%	100%
Free LED	Standard LED	10	6,820	246,475	22.51	246,441	22.51	100%	100%
Business Office Lighting	Standard LED	10	12,075	436,390	36.23	436,330	39.85	100%	110%
Business Office Lighting	Standard LED	12	4,025	180,722	16.10	180,702	16.50	100%	103%
Business Office Lighting	Standard LED	14	4,025	255,628	24.15	255,628	23.35	100%	97%
Total			**212,013**	**8,423,327**	**715**	**8,478,061**	**777**	**101%**	**109%**

Carryover Savings

The Evaluation Team estimated PY9-claimable carryover savings by multiplying verified gross and net savings from PY7 and PY8 lighting products by their associated PY9 carryover rates. The team determined carryover rates using the 2017 UMP methods.[7] Table 72 below provides a detailed trajectory for all bulbs distributed in PY7 or PY8, including those installed in PY9.

Table 72. ENERGY STAR® Lighting Program Carryover Savings Trajectories for PY7 and PY8 Bulbs

Program Year and Component	Carryover Savings Trajectories by Year				
	PY7	PY8	PY9	PY10	PY11
PY7 Online Store	64%	36% x 24% = 9%	27% x 24% = 6%	21% x 24% = 5%	N/A
PY7 BOL	67%	33% x 24% = 8%	25% x 24% = 6%	19% x 24% = 5%	N/A
PY7 Low-Income Free LED Kits	61%	39% x 24% = 9%	30% x 24% = 7%	21% x 24% = 5%	N/A
PY8 Online Store (Lighting)	N/A	64%	36% x 24% = 9%	27% x 24% = 6%	21% x 24% = 5%
PY8 BOL	N/A	67%	33% x 24% = 8%	25% x 24% = 6%	19% x 24% = 5%
PY8 Low-Income Free LED Kits	N/A	61%	39% x 24% = 9%	30% x 24% = 7%	21% x 24% = 5%

Note: Green highlights indicate carryover rates applied in PY9.

In PY10 through PY12, savings from bulbs DESC distributed in PY9 will be claimable as carryover. Table 73 below provides the detailed trajectory for lighting products distributed in PY9.

Table 73. ENERGY STAR® Lighting Program Carryover Savings Trajectories for PY9 Bulbs

Program Component	Carryover Savings Rate by Installation Year			
	PY9	PY10	PY11	PY12
Online Store (Lighting)	64%	36% x 24% = 9%	27% x 24% = 6%	21% x 24% = 5%
BOL	67%	33% x 24% = 8%	25% x 24% = 6%	19% x 24% = 5%
Low-Income Free LED Kits	61%	39% x 24% = 9%	30% x 24% = 7%	21% x 24% = 5%

Note: Some Energy Saver kits sold through the Online Store include non-lighting products. In these cases, the lighting ISR and carryover trajectory only applies to the included lighting measures.

[7] Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. Chapter 6: Residential Lighting Evaluation Protocol. Section 4.10 In-Service Rate. December 2017.

Appendix B. Home Energy Check-up Detailed Methods

Carryover Savings Calculation

The Evaluation Team calculated carryover CFL and LED savings for bulbs placed in storage in PY6, PY7, and PY8, with expected installation in PY9. For bulbs placed in storage in PY6 the Evaluation Team applied assumptions from the 2014 UMP.[8] For bulbs placed in storage in PY7 and PY8, the Evaluation Team applied assumptions from the updated 2017 UMP.[9]

Carryover Calculation Method for Bulbs Distributed in PY5 and PY6

The 2014 UMP indicates that most bulbs placed in storage (up to 97%) become installed within four years of purchase (including the initial program year) and recommends calculating the ISR when stored bulbs are installed as follows:

ISR for Bulbs in Storage

$$ISR_{Year\ 1} = ISR_{Surveyed}$$

$$ISR_{Year\ 2} = (Storage\ \%_{Year\ 1} * 41\%) + ISR_{Surveyed}$$

$$ISR_{Year\ 3} = (Storage\ \%_{Year\ 1} * 69\%) + ISR_{Surveyed}$$

$$ISR_{Year\ 4} = 97\% - ISR_{Year\ 3}$$

Where:

$ISR_{surveyed}$	=	ISR from self-reported survey results for the year the measure was distributed (initial program year)
$ISR_{Year\ 2}$	=	Percentage of stored bulbs installed in Year 2 (one year after program participation)
$ISR_{Year\ 3}$	=	Percentage of stored bulbs installed in Year 3 (two years after program participation)
$ISR_{Year\ 4}$	=	Percentage of stored bulbs installed in Year 4 (three years after program participation)
$Storage\%_{Year\ 1}$	=	Percentage of bulbs placed in storage for the year the measure was distributed
41%	=	Total percentage of bulbs installed (of original bulbs placed in storage) within two years, including the program year
69%	=	Total percentage of bulbs installed (of original bulbs placed in storage) within three years, including the program year
97%	=	Total assumed percentage of bulbs installed (of original bulbs placed in storage) within four years, including the program year

[8] Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. Chapter 21: Residential Lighting Evaluation Protocol. Section 4.12 In-Service Rate. December 2014.

[9] Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. Chapter 6: Residential Lighting Evaluation Protocol. Section 4.10 In-Service Rate. December 2017.

In summary, the 2014 UMP assumes that 41% of all bulbs placed in storage are installed in the next year, 28% of the remaining stored bulbs are installed the following year, and up to 97% of all stored bulbs will be installed by the end of the fourth year (including initial program year in which bulbs were distributed).

Carryover Calculation Method for Bulbs Distributed in PY7

The 2017 UMP's revised approach is attributed to a 2017 Massachusetts panel study, which found that 24% of the LEDs that went into storage in year one were installed in year two. To estimate the lifetime ISR, the UMP directs evaluators to assume customers continue to install LEDs in storage at a rate of 24% of stored bulbs each year and recommends calculating the percentage of bulbs in storage that are installed each year as follows:

Equation 3. ISR for Bulbs in Storage

$$ISR_{Year\ 1} = ISR_{Surveyed}$$

$$ISR_{Year\ 2} = \left(100\% - ISR_{Surveyed}\right) * 24\%$$

$$ISR_{Year\ 3} = \left((100\% - \left(ISR_{Surveyed} + ISR_{Year\ 2}\right)\right) * 24\%$$

$$ISR_{Year\ 4} = \left(100\% - \left(ISR_{Surveyed} + ISR_{Year\ 3}\right)\right) * 24\%$$

Where:

$ISR_{surveyed}$	=	ISR from self-reported survey results for the year the measure was distributed (initial program year)
$ISR_{Year\ 2}$	=	Percentage of stored bulbs installed in Year 2 (one year after program participation)
$ISR_{Year\ 3}$	=	Percentage of stored bulbs installed in Year 3 (two years after program participation)
$ISR_{Year\ 4}$	=	Percentage of stored bulbs installed in Year 4 (three years after program participation)

Results

Participants placed in storage approximately 33% of PY6 CFLs, 21% of PY6 LEDs, 33% of PY7 CFLs, 21% of PY7 LEDs, and 26% of PY8 LEDs received through the program. Table 74 summarizes the percent of stored bulbs expected to be installed in the three years following the initial program year.

Table 74. HEC Percentage of Stored Bulbs Installed by Year

Distribution Year	Bulb Type	% Stored Bulbs Installed in PY8	% Stored Bulbs Installed in PY9	% Stored Bulbs Installed in PY10	% Stored Bulbs Installed in PY11
PY6	CFL	28%	7%	N/A	N/A
PY6	LED	28%	4%	N/A	N/A
PY7	CFL	24%	24%	24%	N/A
PY7	LED	24%	24%	24%	N/A
PY8	LED	N/A	24%	24%	24%

To calculate the carryover CFL and LED savings, the Evaluation Team used self-reported ISRs and applied the equations above to estimate the number of stored CFLs and LEDs distributed from PY6 to PY8 but installed in PY9. Table 75 summarizes the number of stored CFLs and LEDs installed in PY9. The evaluation includes savings for a total of 622 CFLs and 1,425 LEDs.

Table 75. Quantity of CFLs and LEDs Installed in PY7

Distribution Year	Measure	% Stored Bulbs Installed in PY9	Total Volume in Storage [a]	Volume Installed in PY9
PY6	13W CFL	7%	3,865	279
PY6	9W LED	4%	388	14
PY7	13W CFL	24%	1,431	343
PY7	LED [b]	24%	1,333	320
PY8	LED [b]	24%	4,544	1,091
		Total	**11,560**	**2,047**

a. For PY6, total volume in storage as of first year of distribution, and for PY7 and PY8, total volume in storage as of PY8
b. Various wattages

Table 76 summarizes the additional carryover gross savings from the stored CFL and LED measures installed in PY9, applying recommended deemed savings values for the year in which the bulbs were installed (PY9).

Table 76. HEC Carryover Gross Savings (Savings Added to PY9)

Distribution Year	Measure	Volume Installed in PY9	Ex-Post per-bulb Savings		Total Gross Carryover Savings	
			KWH	KW	KWH	KW
PY6	13W CFL	279	32.85	0.003	9,179	0.84
PY6	9W LED	14	37.23	0.003	507	0.05
PY7	13W CFL	343	32.85	0.003	11,279	1.03
PY7	LED [a]	320	43.36	0.004	13,870	1.27
PY8	LED [a]	1,091	43.36	0.004	47,289	4.32
	Total	**2,047**	**N/A**	**N/A**	**82,124**	**7.50**

a. Various wattages

Table 77 summarizes the additional carryover net savings from the CFL and LED measures installed in PY9, applying the same NTGRs from the initial distribution year.

Table 77. HEC Carryover Net Savings (Savings Added to PY9)

Distribution Year	Measure	Total Volume Installed in PY9	Total Gross Carryover Savings		NTG		Total Net Carryover KWH Savings	
			KWH	KW	KWH	KW	KWH	KW
PY6	13W CFL	279	9,179	0.84	0.79	0.74	7,251	0.62
PY6	9W LED	14	507	0.05	0.79	0.74	401	0.03
PY7	13W CFL	343	11,279	1.03	0.79	0.74	8,910	0.76
PY7	LED [a]	320	13,870	1.27	0.79	0.74	10,958	0.94
PY8	LED [a]	1,091	47,289	4.32	0.62	0.62	29,319	2.68
	Total	**2,047**	**82,124**	**7.50**	**N/A**	**N/A**	**56,839**	**5.03**

a. Various wattages

Appendix C. EnergyWise for Your Business Detailed Methods

This section provides additional detail on the impact evaluation approach and findings for the EWfYB program. Since the PY9 program was administered and performed similarly to the PY8 program, the Evaluation Team leveraged results from the PY8 evaluation analysis and include some discussion of those results here.

Desk Review Sample Design

This PY9 analysis uses the results of the PY8 detailed review. The PY8 project desk review samples for Prescriptive Lighting, Custom, and Other Prescriptive Non-Lighting were stratified random designs. The samples for Prescriptive New Construction Lighting and Unitary HVAC were simple random samples.

PY8 EWfYB Realization Rates

For those application types for which the Evaluation Team demonstrated the PY9 program activities are very similar to PY8 program activities, the Evaluation Team applied the PY8 realization rates resulting from more rigorous measure-level evaluation activities to the PY9 program.

The PY8 realization rates were developed from the results of sampled project desk reviews extrapolated to the population. PY8 realization rates by application type are shown in Table 78.

Table 78. PY8 EWfYB Realization Rates by Application Type

Application Type	Gross RR	
	MWH	MW
Prescriptive Lighting	103%	93%
Custom Incentives	99%	103%
Prescriptive Unitary HVAC	67%	125%
Prescriptive New Construction Lighting	102%	74%
Prescriptive Chillers	183%	101%
Other Prescriptive Non-Lighting	94%	100%

Unitary HVAC and Chiller Projects

The PY8 realization rates for Unitary HVAC (67% for energy and 125% for demand) were driven by an update to align baseline efficiency values with and the 2019 CEAM and ASHRAE 90.1 2013 standards, effective January 1, 2018. Table 79 shows the results of PY8 desk reviews for the 20 sampled unitary HVAC projects.

Table 79. PY8 EWfYB Unitary HVAC Project Realization Rates

Project	Ex-Post KWH	Ex-Post KW	Energy RR	Demand RR	Reasons for Differences
1	194,551	47.0	77%	109%	Ex-post uses minimum baseline efficiency values aligning with federal standards as of January 1, 2018 based on size of equipment being >65 kBtuh.
2	109,145	31.2	81%	147%	
3	83,858	48.5	60%	142%	
4	15,680	3.3	57%	143%	
5	14,067	1.6	82%	109%	
6	13,868	6.5	N/A	136%	
7	7,587	5.0	52%	198%	
8	6,731	2.9	56%	103%	
9	4,141	2.2	42%	101%	
10	2,527	1.8	59%	215%	
11	1,257	1.0	33%	127%	
12	1,167	0.3	19%	23%	
13	734	1.4	17%	127%	
14	580	0.5	12%	72%	
15	(11,203)	3.5	-39%	N/A	
16	3,268	0.7	100%	49%	Ex-post uses minimum baseline efficiency values aligning with ASHRAE 90.1 2013 based on size of equipment being <65 kBtuh.
17	3,249	2.4	59%	200%	
18	1,120	0.4	71%	71%	
19	1,016	0.1	100%	21%	
20	618	(2.7)	9%	-56%	

For PY8 Prescriptive Chillers, the evaluation team found a misalignment with chiller baseline efficiency values used in ex-ante estimates and those specified in the 2018 CEAM. Ex post estimates incorporated the correct application of 2018 CEAM baseline efficiency values. Table 80 displays the PY8 desk review results for the census of PY8 chiller projects.

Table 80. PY8 EWfYB Chiller Projects Realization Rates

Project	Ex-Post KWH	Ex-Post KW	Energy RR	Demand RR	Reasons for Differences
1	273,051	37.6	203%	101%	Ex-post calculations use CEAM specified minimum baseline efficiencies.
2	148,515	13.7	170%	101%	
3	143,775	11.9	175%	101%	
4	123,652	18.2	168%	101%	
5	30,908	5.0	205%	101%	

For both Prescriptive Unitary HVAC and Prescriptive Chillers, the evaluation team recommended in the PY8 evaluation report that the program administration update the baseline assumptions used in the ex-ante savings calculations.

Adjusted Realization Rates

For projects with application start dates after November 1, 2018, the Evaluation Team confirmed that the Program Administrators updated the baseline efficiency values for PY9 Prescriptive Unitary HVAC and Prescriptive Chillers as recommended in the PY8 evaluation report.

To calculate adjusted realization rates for these application types, the evaluation team revisited desk review results for PY8 projects. It removed the effect of baseline efficiency updates on ex-post savings results. Due to this being the main driver of differences in PY8 ex-post estimates, a realization rate of 100% was calculated for application to PY9 projects with application start dates after November 4, 2018. PY9 projects with application start dates before this date were confirmed not to have updated baseline efficiency values and have unadjusted PY8 realization rates applied to ex-ante savings for developing ex-post estimates.

When calculating adjusted realization rates for unitary HVAC, the evaluation team excluded one of the twenty reviewed PY8 projects (project #20 in Table 81) due to the unique nature of the reason for the difference between ex-ante and ex-post savings estimates and our expectation that a similar error would not occur in a future program. A review of ex-ante worksheets revealed that the program administrators input identical values for baseline and installed IEER resulting in a claimed savings value of zero for this program. The evaluation team estimated ex-post savings in alignment with the 2018 CEAM, relying on worksheet listed values for baseline and installed EER (non-identical values). Resulting ex-post savings estimates were non-zero. The PY9 program database included no unitary HVAC records with zero claimed total KWH savings. Thus, the evaluation team excluded this project when calculating adjusted realization rates for PY9.

Table 81 details the adjusted realization rates, along with the adjustments made.

Table 81. Adjusted Realization Rates

Project	Unadjusted PY8 RRs		Adjusted PY8 RRs		Adjustments Made
	Energy	Demand	Energy	Demand	
1	77%	109%	100%	100%	Baseline efficiency values aligned with those specified in 2018 CEAM (to represent the baseline changes incorporated into the PY9 program).
2	81%	147%	100%	100%	
3	60%	142%	100%	100%	
4	57%	143%	100%	100%	
5	82%	109%	100%	100%	
6	N/A	136%	100%	100%	
7	52%	198%	100%	100%	
8	56%	103%	100%	100%	
9	42%	101%	100%	100%	
10	59%	215%	100%	100%	
11	33%	127%	100%	100%	
12	19%	23%	100%	100%	
13	17%	127%	100%	100%	
14	12%	72%	100%	100%	
15	-39%	N/A	100%	100%	
16	100%	49%	100%	100%	
17	59%	200%	100%	100%	
18	71%	71%	100%	100%	
19	100%	21%	100%	100%	
20	9%	-56%	N/A	N/A	Project excluded